The Arte of *Nauigation*,

Conteining a compendious description of the Sphere, with the making of certayne Instrumentes and Rules for Nauigations, and exemplified by many Demonstrations. Written by Martin Cortes, Spaniarde. Englished out of Spanishe by Richarde Eden, and now newly corrected and amended in diuers places.

1584.

VVhereunto may be added at the wyll of the byer, another very fruitefull and necessary booke of Nauigation, translated out of Latine by the sayd Eden.

And printed by Iohan Iugge Wydowe.

To the ryght woorshypfull Syr Wylliam Garerd Knyght, and Maister Thomas Lodge, Aldermen of the Citie of London, and gouernours of the honourable Felowshyp or Societie, as well of certayne of the Nobilitie, as of Merchauntes Aduenturers, for the discouery of Landes, Territories, Ilandes, and Signories vnknowen, and not before their fyrst aduenture or enterpryse by Sea or Nauigation commonly frequented.

And to the ryght woorshypfull the reste of the Assistentes, and Comminaltie of the same Societie, Richarde Eden *wysheth health and prosperitie.*

WHAT so euer he was (ryght honorable and woorshypfull) that fyrst beleeued that the frame and cooptation of the body of man, with the functions, offices, and ductes of the partes and members of the same, knytte togeather in a certayne knotte to a common ministration, dyd represent a lyuely image and similitude of a perfect Common wealth: I thinke that he was a man of no vulgar iudgement, or abiecte minde, but rather of singuler wisedome and prudence, in the contemplation of diuine and humane thynges. For he sawe, that as in the small natiue seede of al growyng or lyuyng thynges, is contayned the fourme that bryngeth them to theyr perfection; so in certayne small and obscure members of the Common wealth, consysteth no small encrease to the perfection of the whole. He sawe lykewyse, that therein, as in the body of man, representyng the partes and members of the worlde (as I haue sayde) are dyuers partes of dyuers and sundry actions and motions, greatly differyng in fourme, number, and quantitie, yet all the same to be so knyt togeather,

and so to consent in one vniformitie, to the common profite of the whole, that a greater concorde and harmonie can not be imagined, then is proportioned by the friendly mittie of diuers and contrary. We sawe lykewyse in the same, suche a mutuall compassion of parte to parte, and member to member, by one common sense existent in them all, that no one part or member can feele eyther ioy or payne, but that in manner all the other are partakers thereof more or lesse, yf they be lyuely members, and not wythered, or otherwyse vnsensate by reason of dead flesh, which onely by cutting and burnyng ought to be deuided from the sounde and whole. But as in man (whom Plato calleth the lesse worlde) the vigoure and agilitie of the immortall soule and mynde, neuer ceaseth from continuall mouyng, but is euer exercised in excogitations and inuentions of great thynges (herein resemblyng GOD, whose caracte it beareth) by prouidence foreseeyng, and by intelligence vnderstandyng, and deuising what is to be done, and what to be eschewed, doth immediatly moone and rayse vp the faculties, powers, and members of the body to execute the same: Euen so, in the greater worlde, the prouidence of God, and vniuersall counsayle and consent of men, hath elected and appointed certayne principall men, to beare lyke rule and authoritie in the body of the Common wealth, as hath the intellectiue soule in the members of our body to moone and commaunde the same. The Princes therefore, Counsaylours, Rulers, Gouernours, and Magistrates, as to the most intellectiue and sensitiue partes of the societie of men, hath GOD and Nature geuen preeminence and gouernaunce of the Common wealth, that by theyr prouidence, foresedome and ayde, it may vniuersally flowrishe, not onely by iust administration of good lawes, with due correction of malefactours, but also by lyberall rewardyng of suche as haue well deserued, and especially by mayntenaunce of suche Artes and Sciences, as the Common wealth can not well be without. And to drawe nearer to the applying of my similitude, I say, that what so euer vertue, what so euer arte, or the ingenious industry of men, hath to this day inuented, all the same is to be imputed to the beneuolence and liberalitie of

such

ſuche as haue honourably mayntayned and freely rewarded the trauayles, payues, and charges of them that haue ſpent theyr liues goodes, and wittes (as many haue done) in the inuentions of neceſſarie and profitable artes and ſciences. For euen as wholeſome and temperate ayre, with ſeaſonable weather, and fauourable influence of the heauens and planettes, cauſeth fruitefulneſſe on the earth, and contrarywyſe, barrenneſſe by the contrary: Euen ſo the fauour of Pryuces and Magiſtrates, nouriſheth, augmenteth, and amplyfieth, all artes and ſciences by liberalitie, and extinguiſheth the ſame by miſerable couetouſneſſe and parcimonie. And although in ſome men of rare and noble nature, the deſyre of honour and fame, onely for vertues ſake, and ſtudie towarde their countrey and common wealth, haue mooued them (in maner to their owne vndooyng, thoughe theyr great loſſe and hynderance) to ſet fooyth and inuent diuers thynges for the commoditie of the common wealth and other, rather then for their owne: yet vndoubtedly, who ſo wel conſydereth, and indifferently wayeth that I haue ſayde, ſhall fynde and ſee by dayly experience, that in maner onely munificence, liberalitie, and rewarde, or the hope therof, geueth ſpurres to them that attempt great and vertuous enterpryſes, as I coulde moze largely proue by ſo many teſtimonies of hyſtozies, both holy and prophane, that the rehearſall thereof ſhoulde be but tedious, and not greatly neceſſary for my purpoſe, eſpecially wrytyng vnto your honoures and wooꝛſhyppes, of whoſe munificence, and liberalitie, I haue had great experience, both in my ſelfe, and others, who by your ayde and maynteynaunce, haue attempted, and perfourmed many goodly inuentions, viages, nauigations, and diſcouries of landes and ſeas, heretofoze vnknowen.

Wherein, what great charges you haue ſuſteyned, and howe liberall and conſtant you haue been in furtheryng the ſame, doth well declare, that hytherto you are rather loſers then gayners thereby. The whiche thyng doubtleſſe, is moze to your commendatiõ, in that it may hereby appeare that you haue attempted the ſame, rather for knowledge and vertues ſake, then for couetouſneſſe of gaynes: as is furthermoze well knowen by your fyrſt viages of diſcouerie attempted to Cathay, by the North-

eaſt ſeas, vpon certayne loſſe & detriment, for vncertaine hope eyther of gaynes, or of any ſuche way to be founde, otherwyſe then by certayne lykely coniectures: not much vnlyke to the ſhyning flowres of Marchaſytes, whiche outwardly appearyng in minerall mountaynes, are ſignes and tokens whereby is coniectured what metall is contayned therein, and whether the ſame is to be folowed or not. And although it ſometyme ſo chaunce, that ſuche ſignes are fayleable, ſhewyng more in appearaunce, then they contayne in ſubſtaunce: yet are not ſuche ſignes, tokens, or ſhewes to be contemned, but rather earneſtly to be folowed, for as much as it hath been often proued, and found by experience, that by folowyng the ſame, haue ben found great and ryche mynes of mettalles, as Georgius Agricola in his bookes De rebus metallices, dooth largely declare and prooue by many examples. But to wryte at large what great thynges haue proceeded of ſmal and obſcure begynnynges, and in maner meere coniectures, it would ſo farre exceede the meaſure of an Epiſtle or preface, that it woulde rather encreaſe to the iuſte quantitie of a booke. For in manner al the late diſcoueries both of the Spaniardes and Portugales, had theyr begynnyngs of ſuche ſmall coniectures, with vncertayne hope (as it were præter ſpem ſub ſpe) vntyl GOD and good happe, by the conſtant trauayle and valiaunt mynde of ſuch as fyrſt attempted the ſame, gaue them to enioye that they hoped for. But what ſo euer they haue obteyned, and doo enioye, this may I boldly ſay in your behalfe (ryght honourable and worſhypfull) that there hath not lacked in you eyther the lyke or greater promptneſſe of mind, forwardneſſe in attempting, magnificence in expences, and liberal in rewardes. For beſyde the great charges, and loſſes that you haue ben at otherwyſe, what ſhould I ſpeake of ỳ great giftes that you haue ſent to the Emperour of Ruſſia: What of your laſte chargeable viage of diſcouerie among the innumerable Rockes, Ilandes, and moueable mountaynes of yce in the froſen ſea, by innumerable landes & Ilandes vnknowne to the Antiques, euen vnder and farre within and beyonde the circle Articke, where they thought that no lyuyng creature coulde drawe breath or lyfe for extreeme colde:

whereas

whereas neuertheleſſe the ſame hath been by you diſcouered, euen vnto the mightie ryuer of Ob, that falleth into the Scithian Ocean, or Oceanus Hyperboreꝰ, not farre from the mountaines called Hyperboreus, ſo named, becauſe they are ſituate almoſte vnder the North Pole, and thought therfore to be inacceſſible. A voyage doubtleſſe of ſuch difficultie, and in maner impoſſibilitie, that conſyderyng the infinite dangers thereof (as I haue learned by thinformatiō of Steuen a Burrough, that was then the cheefe Pilot of the ſame voyage) it may ſeeme impoſſible that they ſhould euer haue eſcaped, except the mightie hand of God, by the expert ſkylfulneſſe of ſo excellent a Pilot, had delyuered them from thoſe dangers. And although in deede (as religion byndeth vs) it is conuenient in al thynges to geue al honour, glory, and thankes to God: yet are we not thereby reſtrayned to be thankful to ſuch men, as by their art, ingeniouſneſſe, trauayle, and diligence, haue deſerued both iuſt commendation and large rewarde. And therefore referyng the rewarde to you (ryght honorable and worſhypful, to whom it appartayneth) yf I ſhould not here geue hym at the leaſt ſuche commendation as in my iudgement he hath well deſerued, I myght ſeeme both to defraud hym of his woorthy deſertes, & alſo to forget the freendſhyp and good wyll I beare hym only for his vertues and excellencie in his profeſſion. For certaynely when I conſider how indigent and deſtitute this Realme is of excellente and expert Pilottes, I can doo no leſſe of conſcience, then, in reſpecte of your owne commoditie, yea rather for the commoditie of the Queenes Maieſtie, and the whole Realme, to exhorte you, and put you in remembrance (although I may herein ſeeme to put the Spurres to a runnyng Horſe, as ſayth the Prouerbe) ſo to regarde hym, and eſteeme hym, and his faithfull, true, and paynefull ſeruice toward you, that he may thereby be further encouraged, and not diſcouraged, eyther for lacke of mainteynaunce, or otherwyſe by the iniurious aſſaultes of ſuch his enimies, as onely his vertues and excellencie haue mooued to beare hym diſpleaſure: as enuie doeth euer folowe vertue, as ſayth the Latine Prouerbe, Virtuti comes inuidia. And howe true a ſentence this is, is well verified by the ſaying of a

certayne Philosopher (whose name I do not remember) who hearyng one vaynely reioyce that he had no enimies: answeared, that that was a token he had doone little good: meanyng thereby (as dayly experience proueth) that yf he had excelled in any vertue, he coulde not haue lacked some enimies. And hauing here touched to speake of enuie, I remember that when I was a young scholler, I haue read in the Poet Hesiodus of two kyndes of enuie, whereof the one is called Inuidia, and the other Aemulatio, whiche is more tollerable then the first, for that it is ioyned with some vertue, and enuieth that any shoulde excell him in any excellent qualitie that he professeth. But for asmuch as this enuie of emulation proceedeth of some singuler vertue of them that are so maliced, they may herein reioyce, that they shal euer haue a hundred frendes for one enimie: yea and although they had none, yet is vertue a reward to it selfe, and to be embraced for it selfe onely, as the Philosophers affyrme. What then shal we say to suche, as forgettyng this reward of vertue, do not onely fauour, but rather hynder the preferment and mayntenaunce of suche experte men, more esteemyng certayne Fyshermen that goe a trawlyng for fysh in Catches, or Hongers, and Dredgies for Dysters about the sandes, betweene the South furland & Wyntertonnesse, and the sandes about Temmes mouth, then they doo suche excellent Pilotes as are able without any Rutter or Carde of Nauigation, not onely to attempt long and farre viages, but also to discouer vnknowen landes and Ilandes, as haue done of late yeeres many excellent men, to the great honour and enrychyng of theyr Prince & countrye. But as touchyng Steuen a Borough, the chiefe Pilot of your viages of discouery, it may hereby well appeare, that he is neyther malitious nor enuious of his Art and Science, in that he desireth the same, for the common profite, to be common to al men: and for the same intent was the first that mooued certaine worshipful of your company, as Syr William Garrard, Maister William Hericke, Maister Blase Sanders, and Maister Edwarde Castlen, to haue this worke translated into the Englishe tongue: Who of theyr owne good nature, fauouryng all vertuous studies, and the professours of the same, dyd soone encline

cline to his honeſt requeſt herein, and therewith not only deſired me, but alſo with liberal reward enterteyned me, to take in hand the tranſlation. Which beyng now finiſhed as well as my poore learnyng may perfourme, I deſyre your honours, & woorſhyps, to accept in good part, as I haue ment herein to gratifie you, and doo ſuch ſeruice as my abilitie may ſuffice. Now therefore this woorke of the Art of Nauigation, beyng publyſhed in our vulger tongue, you may be aſſured to haue more ſtore of ſkilfull Pilottes. Pilottes (I ſay) not Pirottes, Rulers, not Rouers, but ſuch as by theyr honeſt behauiour & conditions, ioyned with art and experience, may do you honeſt and true ſeruice: Which is not to be looked for of ſuche as beyng deſtitute as well of the feare of God, as of all morall vertues, ſuperabounde in al notorious vices, accomptyng deſperatneſſe for boldneſſe, raſhneſſe, for hardines, impudencie, for ſtoutneſſe, & crueltie, for manhood. What other thyng (I ſay) is to be looked for of ſuche, then of ſuche trees, ſuche fruites, Et mali corui, malum ouum. But for as muche as theſe haue no place appoynted them in the body of our common wealth, which we haue herebefore compared to the members of the body of man: therefore are they no otherwyſe to be eſteemed, then as excrementes of the body, to whom Nature hath appoynted no place in the ſame, but laboureth continually to caſt them foorth dyuers wayes, leaſt by theyr fylthyneſſe they ſhoulde infect the other members, euen as the pompe of the Shyppe, yf it be not auoyded, is noyous to the Shyppe and all that are therein. But the wyſe and honeſt Pilotte, fyrſt hauyng before his eyes the feare of GOD, and puttyng his chiefe truſt in hym, ſhall ſecondarily truſt in his Art & Science, without any ſuch vaine obſeruations as the ſuperſticious Horoſcopers (Aſtrologiers I meane, and not Aſtronomers) are accuſtomed to vſe in the elections of houres, tymes, and dayes, by conſtellations and aſpectes of the Starres and Planettes, as many fonde men haue done, thynkyng thereby to haue eſcaped ſuche daungers, as they haue thereby the rather fallen into, through contempt of Art and Science, by foolyſhe confydence in ſuperſtitious Aſtrologie: whiche for the vanitie and vncer-

taintie

tainetie thereof, the ryght worshypfull, and of singuler learnyng in all sciences, Syr Thomas Smyth, in my tyme the flowre of the Uniuersitie of Cambridge, and sometyme my Tutor, was accustomed to call Ingeniosissimam artem mentiendi (that is) The most ingenius art of lying. Omittyng therefore the superstitious and phantasticall obseruations of the iudicials of Astrologie, it shalbe better and more necessarie for all Pilottes that desyre to excel in theyr profession, to learne and obserue the principles of this Booke, whereby they may haue suche knowledge of the Sphere, as may instruct them the makyng and vse of diuers goodly Astronomicall instrumentes pertaynyng to the art of Nauigation, by knowledge of the mouynges of the Sunne and Moone in theyr Spheres, and the other Planettes and fyxt Starres: thereby to attayne to the true knowledge of houres, tymes, and tydes, with the variation of the Compasse, and many other goodly naturall obseruations of weather, tempestes, and calmes, by certayne infallible signes and tokens of the same, very necessary to be obserued, and this by the true principles of Astronomie, and not of Astrologie. And this is the true Astronomie, whereof the diuine Philosopher Plato hath written so diuine a sentence, that I haue thought the same here worthy to be alleaged, that by the authoritie of so famous an authour, we may know what is true Astronomie, with the vse and commoditie thereof. Therfore in his booke entituled *Timeus vel de Natura* these are his wordes.

Rerum autem optimarum cognitionem, nobis oculi attulerunt. Nam hæc que de mundo disputantur, nunquam inuenta fuissent, si neque Sydera, neque Sol, neque Cœlum, suscipe potuissent. Cognitio vero diei ac noctis, ab oculis orta, fecit vt dimensione quadam, mensium, annorumque ambitus metiremur, tempus cognosceremus, ac vniuersæ naturæ ordinem scrutaremur. Quibus ex rebus, Philosophiam adepti sumus.

That is to say, our eyes haue brought vnto vs the knowledge of most excellent thynges. For what so euer is disputed of the worlde, had neuer been inuented, yf neyther the Starres, neyther the Sunne, neyther Heauen, coulde haue been seene.

For

For the knowledge of the day and nyght, taking begynning at the eyes, caused vs, as it were by certayne limits and boundes, to measure the circuites of monethes and yeeres, whereby we came to the knowledge of tymes, and the order of vniuersall nature. And hereby also we obteyne the knowledge of Philosophie. &c. And thus by the authoritie of diuine Plato (whom for his excellencie Cicero called Deum Philosophorum, that is, the God of Philosophers) we may vnderstand, that the true Astronomie, is ỳ perfect knowledge of the miraculous mouynges of the planettes, starres, and heauens (and especially of the sunne and moone) wherby is caused the varietie of tymes, & diuersitie of al natural thynges, by natural causes: as by the qualities of Elimentes, as hotte, colde, moyste, and dyye, which are augmented or diminished by the more or lesse influence of these two Luminaries, as they come neare vnto vs at sometimes, or depart further from vs at other tymes, with diuers motions in diuers climates, which causeth not onely varietie of tymes in sundrie climates, but also the varietie of diuers complexions, fourmes, and dispositions of al creatures vnder the face of heauen, none other accidentall contingent, voluntarie, or violent cause, to the contrary notwithstandyng. And this is it that Plato meaneth by these woordes, Vt tempus cognoscceremus ac vniuersæ naturæ ordinem. &c. That is, to knowe the tymes and vniuersal order of nature. And doubtlesse, who so well consydereth the marueylous effectes that are caused, especially by the variable mooving of the Sunne in the Zodiacke, must needes acknowledge it to be the cheefe instrument and meane that God vseth in the generation, preseruation, and alteration of al creatures that are conteyned in the woorlde, of generation and corruption. And for this consyderation, certayne of the auncient Philosophers called it the soule of the woorlde: Other, the eye: and other also, the hart of the woorlde. Plato also affirmeth, that the soule of the woorlde is the Sunne, & that al other lyuyng thynges receiue lyfe from thence. And hereof commeth the saying of the philosopher, Sol & homo, generant hominem: (that is) the Sunne and man, beget man. And therfore (as

wryteth

wryteth Marcilius Ficinus) of al idolaters they are moſt tollerable that honour the ſunne for God. The which, although it be not, yet vndoubtedly are his effects ſo great & wonderful in this inferiour world, that it may ſeeme in manner to be Gods Viceregerent, Liefetenaunt, and Viceroy, in al the workes of nature, except where & when it pleaſeth hym in any thing miraculouſly, otherwyſe then by the common order & courſe of nature, to commaunde the contrarie.

And if it may not be tedious vnto you (ryght honorable and worſhypfull) it ſhalbe a pleaſure vnto me, for the better declaration hereof, to make a briefe diſcourſe of the marueylous and ſtrange effectes that are cauſed by the Sunne: which perhappes fewe haue doone, otherwyſe then diſpearſedly here and there, as occaſion hath ſerued. Fyrſt therfore let vs conſyder what it hath doone ouer the Equinoctial lyne, and vnder both the Poles at one inſtant, diuerſly and contraryly the one to the other. For ſo hath the infinite wyſedome of the great God of nature, the ſupreame Architecture of the vniuerſall world, diſpoſed al thynges in ſuche perfect order, that to them that are vnder the Equinoctial, and haue theyr Horizon paſſyng by the two Poles, the day is of twelue houres, and the nyght as muche, and theyr yeere alſo is deuided into twelue monethes: But they that dwell iuſte and perpendiculerly vnder our Pole, and that haue their Horizon paſſyng ouer the ſayde lyne, haue the day of ſixe monethes: That is to ſay, begynnyng from the tenth day of March, when the Sunne commeth ouer the ſayde Horizon, vntyl it returne to paſſe vnder the ſame at the tenth of September. And contrarywyſe, one nyght of ſixe monethes haue the inhabitauntes vnder the pole Antarticke: whoſe yeere (that is to ſay, all the courſe that the Sunne maketh by the twelue ſignes of the Zodiacke) is accompliſhed in one day and one nyght: a thyng doubtleſſe moſt wonderful and marueylous. Lykewyſe, whē we haue ſommer, they that are vnder our pole, haue the day of ſixe monethes, and they of the oppoſite or contrary pole, haue theyr nyght of the ſame length. Agayne, when it is wynter with vs, then vnder our Pole is the nyght of the ſayd ſixe monethes,

and

and vnder the oppolite Pole, is the day of the ſame length. So that, as it were, courſe by courſe, when we haue the nyght, they haue the day: and contrarywyſe, when we haue the day, they haue the nyght. The which, although it be ſo long, & of ſo great ſpace of tyme, yet is it not continually obſcured with darkneſſe. For the Sunne maketh his courſe in ſuch order, that the inhabitauntes of that part, lyue not duryng that tyme altogeather in darknelles, as Moles lyue vnder the ground, but as other creatures that lyue vpon the globe and face of the Earth, they haue ſuch lyght as may ſuffyſe to ſuſteyne and maynteyne theyr lyfe. For the body of the Sunne declyneth no more eyther beneath the Equinoctiall lyne, eyther aboue the ſame lyne (which is the Horizon to both the Poles) then. 23. degrees, that is to ſay, no lower or hygher then the Tropikes, which are no more then. 23 degrees, or there about, from the ſayd Equinoctiall, that is their Horizon, as is aforeſayd. And yet in theſe. 23. degrees, he maketh not his courſe by the oppoſite Diameter, but goeth continually round about in circuite: ſo that his beames reuerberatyng heauen, repreſent ſuche a manner of lyght, as we haue in Sommer two houres before the Sunne ryſe. And this example whiche we haue taken of the diuerſitie of the Horizons of the Equinoctial, & vnder the two Poles, is to demonſtrate the marueylous effect that the Sunne maketh, departyng from the. xii. houres of the Equinoctiall (that is to ſay, from Aries to Libra) and commyng by lytle and lytle, illuminatyng the Globe of the earth, and ſo reducing the yeere of. xii. monethes, into one onely day, and one nyght, as is ſayd before. Under the infinite varietie of the which courſe, ſometyme with long dayes, and ſometyme with ſhort, all the Inhabitauntes of the worlde are fourmed and diſpoſed, of ſuch ſtrength and complexion of body, that euery of them are proportionate of the Climate aſſigned vnto them, be it hotte or colde, and may dwell and abyde there, as in theyr naturall place, and temperament, not lamentyng, or delyryng to dwell elſwhere, ſo great a loue reſteth in them to theyr native ſituation. But not to departe from the vyage which the Sunne maketh in one whole yeere, as ſometyme

approchyng

approchyng neare vnto vs, and sometyme departyng from vs, I say, that at one selfe same tyme, in diuers partes vpon the round Globe of the earth, it causeth the Spryng, Sommer, Autumne, and Wynter. And neuertheless, at the same instant and punct of tyme, it maketh day and hygh noone in one place, and nyght and mydnyght on the opposite part. The whiche varietie, although it appeare incomprehensible to the slenderneſſe of our wittes, yet beholdyng the same with the eyes of vnderstandyng, and therewith consyderyng the vnestimable mouyng that the Sunne maketh continually, we shall fynde it to be true, hauing respect to the diuers situations of the earth, as it is continually illuminate more or lesse by the Sunne. And this varietie is made with suche a harmonie and consonancie, and suche a lawe perpetuall and immutable, that yf any poynt or pycke thereof shoulde fayle, it is to be doubted lest the Elementes shoulde be confounded togeather, and returne to theyr first Chaos.

And to haue sayde thus much of the wonderfull effectes of the course of the Sunne, it may suffise for an example to proue how necessary a thyng it is, not only for all Pilots & Sea men to haue the knowledge hereof, but also for all other such as shall attempt great and farre voiages in vnknowen landes, & strange countreys, as dyd of late Maister Ienkynson, a worthy Gentleman, set forth by you, and maynteyned at your charges, more lyke an Ambassadour sent from any Prince or Emperour, then from a company of Merchaunt men. Wherein, what commendation you haue deserued, to the increase of your perpetual fame and honour, I referre it to that I haue sayde before. And as touching Maister Ienkynson, what trauayles, paines, and dangers he hath susteined, and hardly escaped, and what diligence and art he hath vsed in the searching of strange countreys, and in the description of those his voyages, it were but in vayne for me to wryte muche vnto you, vnto whom the same is better knowen then to me. And therefore to conclude, with renderyng iust commendations both vnto you and hym, I can say no more, but as Plato wryteth in his Booke *De Legibus*, Decens est eos ciues laudibus ornare, qui corporis vel animi viribus, res arduas præclaras que gesserunt, & legibus libenter paruerunt.

That

That is to say, It is decent to commende those Citizens, that by theyr industry of body and mynde, haue done great affayres, and haue wyllyngly obeyed good lawes. And thus eftsones desiryng your honours and worshyppes to accept in good part whatsoeuer I haue sayd of good wyll and affection towarde you and your proceedynges, and with your shielde of iustice and auctoritie, to defende me agaynst the assaultes of such as are enimies to vertue, and captious of other mens doynges, I rest at your commaundement to the vttermost of my power, to do you what seruice I may.

(.˙.)

¶ The Epistle Dedicatorie of Martin Cortes, to the most mightie and victorious Monarch Charles the Emperour, the fyfth of that name, King of Spayne.

SO greatly were esteemed the inuentours of certayne Artes and Sciences in auncient tyme (as wryteth Saint Augustine in his bookes De Ciuitate Dei) that they tooke them not for mortall men, but honoured them as immortall gods. His wyfe *Isis.* in Egypt, ordeyned common weales with iust gouernaunce, gaue them lawes, and knowledge of letters, and taught them alsa the vse of Flexe. In consideration wherof, she was honoured of such as then knewe her, and reuerenced of them that came after her: In so muche, that they establyshed a capitall penaltie or punyshment of death, agaynst all suche as eyther in sporte or in earnest affyrmed her to be an earthly woman, and not rather a diuine Goddesse. Ceres beyng of lyue- *Ceres.* lye witte and cleere vnderstandyng, beholdyng in the Cicilians *The Cicilians.* humane similitude and shape to the outwarde appearance, and inwardly the fiercenesse of bruite beastes: hydeled theyr customes, and reformed them with newe Statutes, teachyng them to tame Oxen to beare the yoke, to sowe Wheate for theyr great commoditie, to grynde in the Mylle, to kneade in the house, and to bake in the Ouen. In recompence whereof they made sacrifice vnto her, and buylded many sumptuous Temples in honour of her. Saturnus comming from Creta, gaue lawes vnto the Latines, whereby they myght gouerne them selues, and prescribed them maners of lyuyng, teachyng them to Tyll and Manure the grounde, and sowe Corne, and to gather rype fruites in due season. And yf Saturne were profitable to those nations, and they not vnthankfull vnto hym, in that they buylded hym aulters, celebrated vnto hym festiuall dayes, and accompted hym in the number of the heauenly Goddes, namyng

The first inuentours of Artes.

Saturne gaue Lawes to the Latines.

Tillage of the grounde.

hym also the father of the Gods. And (yf I say) he was to them so profitable, and that worlde iudged so happy and prosperous for hauyng so valyaunt a King, and so iust a Lawe geuer, that it was therfore by the mouthes of al men called the *GOLDEN WORLDE*, and *RAIGNE OF SATVRNE*: Certes, except I greatly deceyue my selfe, this our tyme is nothyng inferiour to that. For we knowe certaynely that your Maiestie hath been more profitable to Spayne, then euer was Saturne to the Latines: and also a more excellent Lawe geuer, in maner to all Europe, and further, to the newe Worlde, lately discouered, then he that gaue Lawes but onely to a lytle corner of Italie. Whereby I consyder, that the felicitie of your Maiesties tyme, hath been no lytle commendation to your doinges, in that you haue banyshed vice, honoured vertue, punyshed offendours, and fauoured innocentes: so that the quiet haue thereby lyued more peaceably, the vnquiet restrayned, the good exalted, and the euyll chastised: In so muche that nowe, by reason of iust ministration of good order in your Maiesties dominions, they that walke in the nyght, goe in safetie, whereas we knowe, that in other Prouinces, suche as walke in the day goe in daunger and perill. And therefore in the moste happie tyme of your Maiestie, it appeareth that Spayne is renewed, not onely in the excellencie of Mechanicall or handy crafties, but also in the knowledge of letters and discipline of warre: In so muche, that she that sometyme lacked her selfe, may nowe abundantly minister to her neyghbours that haue neede. And whereas to your imperiall Maiestie, it shoulde not suffice to obeyne lawes, yf power and armes shoulde fayle to defende and punyshe: who, comparable to your Maiestie, enioyeth the one, and wanteth not the other, hauyng tryumphed ouer Kynges and Kyngdomes, enlargyng also the name of Spayne in many vnknowen and barbarous Landes and Nations? Greater duetie therefore owe your Subiectes vnto you, then euer did the Egyptians to Isis, or the Cicilians to Ceres, or the Latines to Saturne, for as muche as they haue receyued of your Maiestie more common and profitable benefites. It is not long since your Maiestie hath for-

bydden

The golden worlde, and raigne of Saturne.

The worthie factes of Charles the fyfth.

Sicilia.

Spayne renewed.

The triumphes and victories of Charles the fyfth.

hyddeu and abolyshed the vse of Mules, and restored agayne the exercise of Armes, so long out of vse, that the one with the other, hath been no small profite and commoditie to your Subiectes and dominions. For by takyng away the vse of Mules, is so encreased the number of Horses and Horsemen, that suche as before neuer durst or could, in manner lyght by vppon a Horse, can nowe easily and aptly manege them. So that you seeme to haue reuiued the dayes of Bellerophon the sonne of King Glaucus, and lykewyse the tyme of Saturne, when men had first the knowledge how to make Horses to abyde to bydle, and to byng them vp to serue for dyuers vses and necessities of men. And ryght sure I am, that by reason of suche laudable statutes and ordinaunces in your dominions, shall fayle neyther Horses nor Horsemen, aswell for the Courte, as for the Campe. Who knowe in manner howe to gyde a Swoorde, before that your Maiestie permitted weapons and armour to be worne, euen in your Courte, and that els where all men myght do the lyke: before which tyme dexteritie fayled, where courage abounded. Ouer and besyde the profite and commoditie that hath ryssen hereof, what honour you haue obteyned by the same, is manifest by Frauncis the Frenche King, who by your Maiestie beyng taken pryssoner in the parke of Pauia, was brought to Madrid, in the yeere a thousande fyue hundred twentie and fyue, where seeyng many young men in manner without beardes, and yet laden with armour and weapons, sayde, O happie Spayne, that bryngest footh and nourysshest men of Marte. In your most happy dayes also, the Christian fayth is amplyfied, and in manner whole Spayne flozysheth dayly more and more in sumptuous buylbynges, and is abundantly enryched in treasure brought from your Indies, farre surmountyng the eyches of Solomon brought from Ophir. Yea and to say the trueth, consyderyng the Nauies of golde & syluer, which haue ben ordinarily brought from thence to your Maiestie, this tyme may rather be called the golden age, then that of Saturne. Not omitting also, that by your prosperous attemptes, haue been discouered so many Landes and Ilandes, heretofore so vnknowen to the Cosmographers, Geogra-

Mules.

Horses and Horsemen.

Bellerophon.

Wearyng of weapons and armour.

Frauncis the French king taken prisoner.

The Christian fayth enlarged.
The sumptuous buyldinges and ryches of Spayne.
The Indies nauies of golde and syluer.

Newe landes and Ilandes discouered.

phers & Hiſtoriographers, that they neuer hearde of theyr names. Which neuertheleſſe are now ſo well knowen to your ſubiectes, that they haue troden them with theyr feete, and meaſured them by paſes. Who before this tyme euer hearde any mention of the ryche and large Prouince of Peru, or of the ſtrayghtes of Magalianes, or of the ryuer of Syluer, called Rio de la Plata. They in tyme paſt ſeemed to haue doone no ſmall thyng, when they had knowledge of the fortunate Ilandes, the which, ſince they were conquered by your Maieſties Graundfather, haue been called the Ilandes of Canaria. And yf it be, and hath been muche to diſcouer and ſubdue this newe worlde: it is doubteleſſe no leſſe glory to your Maieſtie, not onely to poſſeſſe and enioy it, but alſo that you dayly procure to ſende thyther Iudges to gouerne with lawes, and Preachers to inſtructe in doctrine, to bryng thoſe Indians to the knowledge and honouryng of the true GOD. And therefore conſyderyng your Maieſties godly deſyre and purpoſe, as touchyng theſe Nauigations, and the daungers of ſuche as goe to diſcouer this newe worlde (although it be not newe to the Spaniardes to trauayle into farre Countreys, for as muche as in the dayes of Caius Cæſar, the ſonne of Auguſtus, were founde broken peeces of Spanyſhe Shyppes, loſt in the Gulfe of Arabie, as alſo Celius Antipater affyrmeth, that certayne Shyppes of Spayne were accuſtomed to ſayle for merchaundize to the Eaſt partes of Ethiope) in conſyderation hereof, haue I the more willyngly publyſhed theſe my trauayles, for the furtheraunce of all ſuche as ſhall hereafter attempte the lyke Nauigation. And here doo I not ſay that Nauigation is not a thyng of antiquitie. For we reade that in olde tyme, the Argonanti ſayled to Colchos, and Danaus brought the fyrſt Shyppe from Egypt to Greece. But I ſay, that I am the fyrſt that haue brought the Arte of Nauigation into a briefe compendiouſneſſe, geuyng infayleable principles, and euident demonſtrations, deſcribyng the practiſe and ſpeculation of the ſame, geuyng alſo true rules to Mariners, and ſhewyng wayes to Pilottes, by teachyng them the makyng and vſe of Inſtrumentes, to knowe and take the altitude

Peru.

The ſtraightes of Magalianes.

Rio de la Plata

The fortunate Ilande, or Canaries.

Religion in the Indies.

The Spaniardes haue euer trauayled into far countries.

The antiquitie of Nauigation.

Argonanti.

Colchos.

The Art of Nauigation.

Thynges parteynyng to Nauigation.

titude of the Sunne, to knowe the tydes or ebbing and flowyng of the sea, howe to order their cardes and compasses for nauigations, geuyng them instructions of the course of the Sunne, and motions of the Moone: teachyng them furthermore the makyng of dyalles, both for the day and for the nyght, so certayne, that in all places they shall shewe the true hours without default: and haue lykewyse declared the secrete propertie of the Lode stone, with the maner and cause of the Northeastyng and Northwestyng (commonly called the variation of the compasse) with also instrumentes thereunto belongyng. And that, that which I shal say or doo, be not accompted to be presumptеously done or spoken, I acknowledge that whatsoeuer I haue wel doone or written, it is from aboue by the helpe of the diuine grace, and by the fauoure and prosperous fortune of your Maiestie. And thus shall they that nowe lyue, and lykewyse they that shall succede vs, see and perceyue, howe muche more the world oweth and is behouldyng to your Maiestie, then were the auncient Egyptians to theyr Isis. She gaue them letters to reade, but your Maiestie hath geuen rules and orders to saile on the seas. The profite of Isis was onely for one prouince. But the commoditie that ensueth of your doynges, is vniuersall for all prouinces and nations, and for all seas, aswel to go to places discouered, as also to discouer landes and regions yet vnknowen. If they of auncient tyme had reached that we haue obteyned, the Indies had not nowe been to discouer: neyther should it be esteemed a miracle vnto vs, as at the tyme when Carthage florished, that one Agnus went fooryth from the baye of Cadiz, and sayled to the ende of Arabie. Neyther woulde Cornelius Nepos haue wrytten it for so famous a thyng, that a certayne man flying from kyng Latinus, came from the gulfe of Arabie: Whereby it is manifest, that aswell Nauigation, as other artes, doth from day to day increase, and by lytle and lytle is come to perfection. For in those dayes they had neyther compasse nor carde of saylyng whereby to gouerne them selues. They lacked the consyderation of the starres, vntyl the Pheni-

The lode stone, falsly called in Englysh Adamant, is in Latine called *Magnes*.

Charles the fift greater then the Heroes of olde tyme.

Vniuersal benefites.

Comparison with the antiques.

Plinie

Nauigations of olde tyme.

The perfection of Artes at this day.

The rudenesse of the antiquies.

tians founde the knowlcdge thereof, and were the fyrst that vnderstoode (that to suche as shoulde trauayle by sea) it shoulde be necessarie to lyft vp their eyes to heauen, and consyder the motions thereof. They that sayled to the Iland of Taprobana, (whiche in olde tyme was called Antitono) caryed for theyr voyages lyuyng byrdes. And when they thought good, let certayne of them flee: and by the flyght of theyr wynges, directed the helme and sayles of their shyppes. They sayled onely three monethes in the yeere. To them therefore it was necessarie to obserue and tarie the tyme, vntyll they founde it to serue with a forewynde. They knewe not howe to helpe them selues with the bowe lyne, or syde wynde: neyther sawe they the north starre, or sought it, or had any knowledge thereof. And I beleeue verily that this was the cause of so long a voyage whiche the shyppes of Solomon made, saylyng to Tharsis and Ophir, wherein they spent three yeeres: although in deede that was no short voyage whiche they made, compassynge about India, and many other prouinces. And whereas before I sayde, that Nauigation by lytle and lytle came to perfection, I fynde by auncient hystories, that Tipho fyrst founde the Gouernale or Rudder, Dedalus the Maste and Shrowdes, and Icarus the Sayles, the Thirreni founde the vse of the Anker of one graspe or flooke, & Palaminus brought it to perfection, addyng the other. And thus may it manifestly appeare, that in these prosperous and fortunate dayes of youre Maiestie, it hath pleased GOD to bryng the knowledge of Nauigation to perfection, with this my breefe discourse as touchyng the same, aswell profitable and necessarie for them that trauayle by lande, as by sea. What can be a better or more charitable deede, then to bryng them into the way that wander? What can be more difficulte, then to guide a shyppe engoulfed, where only water and heauen may be seene? One of the foure most difficult thynges, whereof Solomon maketh mention in his prouerbes, is the voyage of a shyp by the sea. The which Galfrede expoundyng, sayth, that in humane thynges, none is more fearefull or more daungerous,

Augurium.

The North Starre

The voyage of Solomon to Tharsis and Ophir.

The first inuentours of Nauigation.

Commodities & difficulties of nauigation.

then

then to aduenture lyfe in a thinne and weake peece of wood, or for a man to commit hym selfe to the rage of furious windes, among the tempestes of the Sea, and there to hasarde that he loueth so well. O how much more should the same seeme difficult to Solomon, yf at these dayes he shoulde see that fewe or none of the Pilottes can scarsely reade, and are scarsely of capacitie to learne: And whereas in the fyrst Chapter of this booke, I haue made mention, that the gouernall or sterage ought to be committed to expert men, and of good vnderstandyng, he should see, that now adayes, the ignorant presume to gouerne other, which were neuer able to rule or gouerne them selues. I most humbly desyre your Maiestie, to receyue in good part this my poore seruice, whiche, although it be lyele, yet beyng dedicate vnto the greatnesse of your regal person, it shalbe much more then great. The profite and commoditie thereof, is notorious, and the benefite that thereby may be receyued, is vniuersal. Iherfore, when your Maiestie shal finde your selfe relaxed frō greater affaires, it may please you to feede your eyes with these my trauailes, you shall finde therein many new, delectable, and witty things, with also many profitable and certayne rules, both to reade & vnderstande. To conclude, I eftsoones make humble petitions to your Emperial Maiestie, not so muche to consyder what I wyte, as to respect the intent of my wytyng: and not the gyft, but the affection & good wyll that remayneth in me to seruc your Maiestie.

The ignorance of Pilottes.

The gouernal.

(·.·)

The fyrſt part of this woorke, *which entreateth of the compoſition* of the worlde, and of the vniuerſall principles for the Arte of Nauigation.

The firſt Chapter, of the generall diſtinction of Creatures.

Three differences of creatures.

Corporal creatures.

THE infinite God, the beginning, and cauſe of the whole vniuerſall, created three orders of creatures, differyng in kinde: that is to ſay, Corporall, as the Elementes, Spirituall, as Angelles, and compounded of theſe two, as Man. The corporall nature is diuided into bryght and ſhynyng bodyes, as the Starres: or into darke and thycke bodyes, as Earth and Mettalles: eyther into Diaphane or tranſparent bodyes, as Ayre and Water. Of theſe creatures (as ſayth Saint Gregorie) ſome haue onely beyng, as Stones, ſome lyue, as Trees, and other haue ſenſe, as Beaſtes, other vnderſtandyng, as Man, who in holy Scripture is called all Creatures, accordyng to the ſaying of Chriſt to his Diſciples, where he ſayth, Goe and preache the Goſpell to all Creatures. And therefore not without good cauſe was Man called of the Greke Philoſophers, *Microcoſmos*, (that is) the leſſe VVorlde. In the which we contemplate thinges of no leſſe admiration, then in the great Worlde. The ſimilitude betweene them both, is, that euen as the great worlde, and the whole Globe or Sphere thereof, is mooued by the voluntarie motion of an intellectiue ſubſtaunce, or an Angel: euen ſo is this. For (as Ariſtotle wryteth) VVhat ſo euer is mooued, is mooued by vertue of an other: As, Man is mooued by the internall or inwarde fourme that is within hym (that is to ſay) by the intellectiue ſoule that is proper vnto hym. In lyke maner, in the great worlde are found dyuers mooueable thynges: All which, are reduced to one immoueable

Man is called all creatures, and the leſſe worlde.

Man compared to the worlde.

All that mooueth, is mooued by an other immoueable. The intellectiue ſoule.

ueable mouer. So in man are founde many thynges mooued by diuers motions, which are al referred to his intellectiue soule. The great worlde conteyneth the creatures within in selfe, and consequently is all really, as hauing nothyng without it. Euen so, man by knowledge is al, and knoweth al things, and nothing naturally is hyd from him, or vnknowen to hym. Agayne, in this lesse humane worlde, are two motions, Intellectiue, and Sensual. Then consequently the great worlde hath two locall motions: the one, wherewith the fyrst moueable is mooued, and draweth with it all the other Spheres from the East to the Weast, and is called Rationall mouyng. The seconde, is the mouyng of the other Spheres, from the Weast into the East: and is called Irrational mouing. But now leauing to speake of the lesse world, we wyl proceede to speake further of the great.

Man knoweth part of all thynges.

Two motions in man.

Primum mobile.

Rational motion.

Irrationall motion.

The seconde Chapter, of the definition of the worlde.

THE worlde (as sayth Isodorus) is heauen and earth, and the other woorkes of God that are conteyned therein. It is compounded of thynges visible, and yet vnsearchable. Moses and Saint John the Euangelist witnesse, that it was made by GOD. The Philosophers called it Mundus a mouendo, because it is in continuall mouyng, and neuer in rest. The Greeks called it Cosmos, whiche signifieth, Fayre, or Beautiful, and so named it, because of the maruelious ornament thereof, and diuersitie of Elementes, with the resplendence or shynyng of the Sunne, Moone, and Starres. And doubtelesse, nothing may be seene with the corporal eyes of man, more beautifull then it is. In so muche that the diuine Philosopher Plato affyrmed, that eyes were geuen to men to beholde the beautie therof, and to take pleasure in the contemplation of the heauenly bodyes, and roundnesse of the worlde, whiche also for the roundnesse thereof, is called Spherical, because that Sphera in the Greke tongue signifieth a rounde body.

What is the worlde.

Or Mundus a Munditie. That is, clearnesse, or fayrenesse.

Eyes were geuen to men to beholde the fayrenesse and beautie of the worlde.

The roundnes of the worlde.

The

The thyrde Chapter, of the definition of the Sphere.

Definition of the Sphere.

THeodoſius ſayth, that the Sphere is a whole and compoſall figure, vnder one ſuperficial: in the middeſt whereof, is a poynt or pycke, from the whiche al ryght lines drawne directly to the circumference, are equall.

The center of the Sphere.

This poynt or pycke, is called the center of the Sphere: accordyng to Euclide, it is the paſſage of the circumference of halfe a circle, whiche is turned rounde about his Diameter that is fixed, vntyll it returne to his owne proper place agayne, as where it was at the fyrſt. By the center of the Sphere, paſſeth a ryght lyne, and the extremities or endes thereof, touch in the circumference. And this lyne (imagined) is called the Axis, or Exeltree of the Sphere, and the endes thereof are called the Poles. Vppon this Axis is the Sphere of the worlde moued.

The Axis and Poles of the worlde.

The fourth Chapter, of the diuiſion of the worlde.

Quinta Eſſentia.

Ariſtotle calleth it the .v. Element.

The v. Eſſence is incorruptible.

What is Element.

The inferiour Elementes are not pure nor ſimple.

IT is to be preſuppoſed, that there is difference betwene Element, and Elementate, and the fyfte, beyng called Quinta Eſſentia. The Quint eſſence, or fyfte ſubſtance, is a body of it ſelfe, differyng from all Elementes, and thynges Elementall, aſwel in matter as in fourme, and no leſſe in nature and vertue: and hauyng in it ſelfe no contrarietie, is certaynly without corruption. And hereof commeth it, that the Philoſophers called the heauens and heauenly bodyes, the fyfth ſubſtaunce, or fyfth eſſence, by reaſon of the incorruptibilitie thereof. Element is that, whereof any thyng is compounded. It is the fyrſt of compoſitions, and of it ſelfe is not compounded. Whereby it foloweth, that neyther the earth, the ayre, the water,

water, nor the fyre, that are neare vnto vs, or about vs, are pure and simple Elementes. For these Elementes doo sometymes myngle them selues one with another, and especially where they are neare togeather, and touche one another. Of these elementes euery part is named by the name of the whole: As euery part of fyre, is called fyre, and euery part of earth, is called earth, and so of the other. They are called simple bodyes in respecte of other compounde and myxt bodyes. They are diuisible into partes of diuers fourmes: and of the commixtion of them, are made and engendred diuers thynges of sundrye kyndes. These foure (that is to meane, Earth, Ayre, Water, and Fyre) although they are named simple, but in respecte as aforesayde, yet are they the Elementes (that is to say) begynnynges and pryncyples of all other compoundes and myxtes. A pure Element, can not be seene, forasmuche as that that is pure, lacketh colour: and that that hath no colour, is not visible. The Elementes (as sayth Isodorus) were diuided by the hand of GOD. The imperial Heauen was replenyshed with Angelles, the ayre with byrdes, the sea with fyshes, and the lande with men, and other beastes. Elementate, is euery body compounded of the foure Elementes. Not that they are Elementes formally, but vertually in myxt bodyes. This knowen, we wyll shewe howe the worlde is diuided into two regions: Celestiall, and Elementall. The region Elementall, which is continually subiect to alterations, is diuided into foure Elementes: which are, Earth, Water, Ayre, and Fyre. These Elementes, the Greekes cal Ylogia, for the communion and concord that they haue betweene them selues. The heauenly or etherial region (called Quinta Essentia) compasseth and conteyneth the Elementall worlde within it.

The elementes are diuisible into partes.

The commixtion of elementes.

Pure & simple elementes can not be seene.

The diuision of elementes.

What is elementate.

Diuision of the world into Celestiall and elementall.

Quinta Essentia.

The fyfth Chapter, of the number, order, and propertie of the Elementes and Heauens.

The

The orders of Elementes.

Earth.
Water.
Ayre.
Fyre.

THE earth (after the Philoſopher) is a pycke or poynt in the middeſt, called the center, to the whiche they aſſigne the loweſt place. Next vnto the earth, and about it, the water occupieth the ſeconde place, and the ayre the thyrde. The fyre is hygher then any of the other elementes. And it is to vnderſtand, that the water hath

The fourme of the water.

two ſuperficials. One, whiche is called concaue, or holowe: the other, conuex or embowyng. You may compare the inwarde part of the concaue to a dyſhe or a bolle, whoſe outwarde part is called conuex. As touchyng the concaue, the water compaſſeth about the earth, leauyng diſcouered that part that ſerueth for the reſpiration and lyfe of men, and other beaſtes. As concernyng whiche, ſome thynke that the Ocean ſea is hygher then the earth: and aſke the queſtion why the ſea couereth not the whole earth, and why the earth is not ſunke in the water? To this it may be a ſufficient anſweare, that it hath ſo pleaſed the wyll of GOD, accordyng to the ſaying of the prophete Dauid: Terminum poſuiſti quem non tranſgredietur, neque conuertetur operire terram. That is, Thou haſte appoynted limittes, which it ſhall not paſſe, neyther ſhall it returne to couer the earth. Beſyde the wyll of GOD, whiche is the cheefe and ſufficient cauſe thereof, we ſay that nature fayleth not in her neceſſaries. For ſhe ſometyme admitteth a lytle inconuenience, to auoyde a greater euyll: as when heauie thynges, whiche naturally ſhoulde deſcende, doo not onely not deſcende, but ryſe vp: And as alſo ſome tyme it chaunceth that fyre deſcendeth, and water aryſeth to fyll the voyde or emptie places, leaſte any where ſhoulde be founde voyde or emptie, whiche nature ſo greatly abhorreth. To this purpoſe, nature foreſeeyng the kyndes of many thynges that coulde not elſwhere lyue then on the earth, neyther be conſerued within the water (as men, and other earthly beaſtes) determined before to make the earth not perfectlye rounde, contrarye to the nature thereof: whereof it foloweth, that it is not altogether

The Ocean Sea.

Pſal. 107.
Iob. 38.

The will of God, is the cauſe of cauſes.

Nature abhorreth emptines.

The earth is not perfectly rounde.

togeather couered of the water. And as (sayeth Origen) the earth remayneth discouered of water, that it might bring forth fruites, trees, and plantes. As touchyng the region aboue the water and earth discouered, are conteyned vnder the concauitie of the ayre, whiche is diuided into three Regions, as the lowest, highest, and middlemost. The lowest is hote, by reason of the reflection or reboundyng of the beames of the Sunne, stryken backe by the earth. The highest also is hote, by participation of the fyre, and nearenesse thereunto. The middle region is colde, as is manifest by the flowe and hayle, engendred in the same. The ayre neare vnto the Region of the fyre, whiche is pure heate, doth neyther burne nor lyghten, because it hath no combustible matter, and so hath it power, and not acte. It is neare vnto, and reacheth the circle of the Moone, whiche compasseth it about. The heauen, or circle of the Moone, is next vnto the heauen of Mercuri: and Mercuri vnto Venus: Venus, vnto the Sunne: the Sunne, to Mars: Mars, to Iupiter: Iupiter, to Saturne, whiche is next, and reacheth vnto the heauen of the Starres, called the Firmament, because that in it are al the Starres (except the planetes) firme and fyxt as a knotte in a table. The knowledge of the planets was had by seuen sundry motions they haue among them selues, and by theyr course, not vniforme to that of the Starres of the eyghe heauen, because that some tymes the planetes appeare vnto vs ioyned togeather, and some tymes diuided. The Christaline heauen compasseth about, or contayneth within it the heauen of Starres. This Christaline heauen, is transparent, and perspicuous, as cleare water or glasse that may be seene through, by reason of the clearenesse and pure substaunce thereof. It is by an other name called, the heauen of water, whereof holy Scripture speaketh saying, Aquæ quæ supra cælos sunt, laudent nomen Domini. That is to say, Let the waters that are aboue the heauens, prayse the name of the Lord. It was created for the conseruation of corporall thinges, and to temper the heate engendred of the mouyng of the fyrst moueable, whiche beyng so great of body, that it not onely compasseth all the Elementes, but also all the inferior heauens is mouued

Diuision of the ayre into three Regions.

The highest ayre is incombustible.

The order of the heauens.

The firmament

The planets.

The Christaline heauen.

The heauen of water.

Psalm. 148.

Daniel. 3.

The mouing of the first moueable.

moued so swyftly, that it dayly perfectly mooueth all the aforesayde Spheres. And leaſt by reaſon of the great heate thereof, cauſed by his swyft motion, it ſhould conſume inferior thinges, GOD ordeyned this Chriſtaline heauen, that the coldneſſe thereof myght temper the extreame heate of the other. This Chriſtaline heauen, reacheth vnto the firſt moueable heauen, called Primum mobile. And this reacheth to the Emperiall heauen, which is the tenth, called Empyrium, by reaſon of his brightneſſe and feruency. This is not moued, and is moſt perfect. The Philoſophers had no knowledge hereof. But we be taught by holy Scripture, that ſurely a heauen there is, and that cannot be the habitation of Angelles, and Spirituall creatures. It is also called Coelum Coelorum, that is, The heauen of heauens: becauſe it conteyneth and includeth within it all the other heauens. It is of greater clearneſſe then all the other heauens, and was created immediatly with the Angelles. In this alſo remayneth the humanitie of Jeſus Chriſt our GOD, and indignitie aboue it. It conteyneth three holy orders or principalities, called, Hierarchias. Whereof the fyrſt is called Supercelleſtial, & hath in it alſo three orders, Seraphins, Cherubins, and Thrones. The ſeconde is called Celeſtiall, and conteyneth Dominations, Principates, and Poteſtates. The third, called Subcelleſtiall, conteyneth Virtutes, Archangelles, and Angelles. And to conclude, it hath aboundance of all goodneſſe and perfect felicitie, with priuation or wante of all euyll. The heauen alſo, geueth influences of conſtancie, ſtedfaſtneſſe, and durabilitie to thynges, againſt the fluxabilitie and inconſtancie of the other heauens: the order whereof, doth appeare in the demonſtration folowyng.

The coldneſſe of the Chriſtaline heauen.

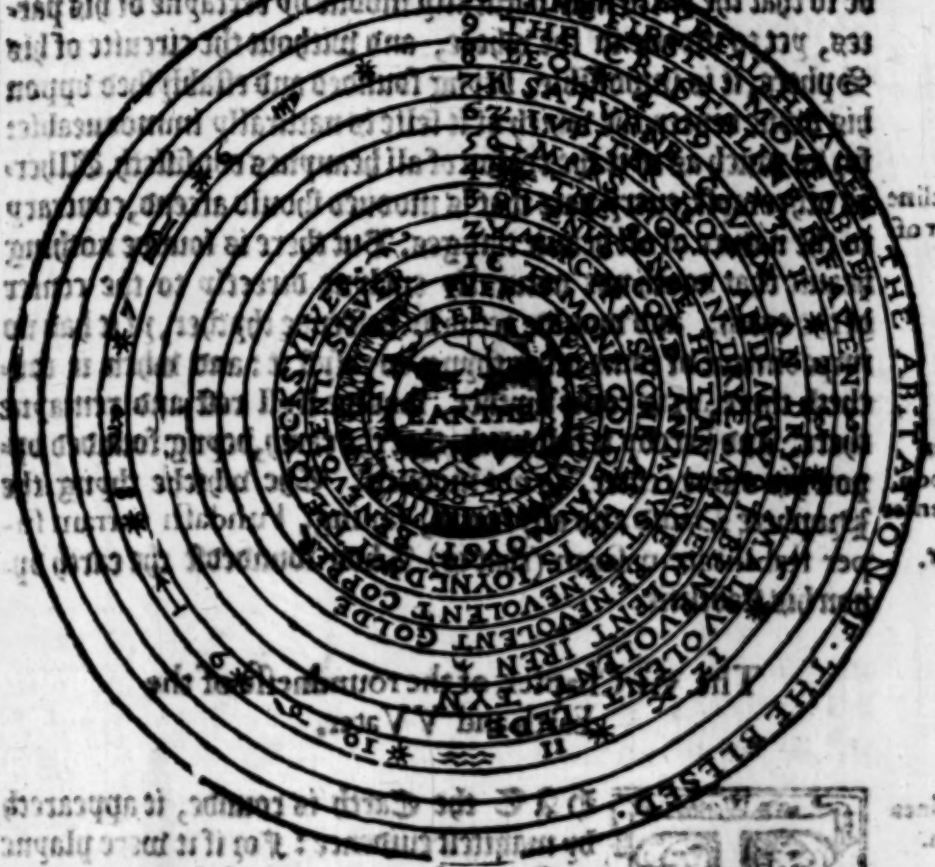
The heauen of the fyrſt moueable.

The heauen called Emperium, is not moued, and is the habitation of Angelles.

The humanitie of Chriſt in the Emperiall heauen.

Three orders of Angelles.

The Emperiall heauen preſerueth all the other heauens.



The vi. Chapter, of the immutabilitie or immobilitie of the Earth.

THe Pythagorians and other auncient naturall philosophers (as sayth Aristotle) were of opinion that the earth dyd moeue, yet not by a sydelonghy motion, but circulerly about the vpmest of one place. The whiche errour both Aristotle him selfe, and the Astronomers doo confute and reprooue by diuers causes, and manifest demonstrations: For circuler motion,

Opinion that the earth moueth. *Molus in loco*

The earth is immooueable.

motion, is proper to the heauens. And as the earth differeth from them in nature, ſo lykewyſe in mouyng. And although it be ſo that the earth may naturally moue by certayne of his partes, yet to moue in the whole, and without the circuite of his Sphere, it is impoſſible, beyng founded and eſtablyſhed vppon his owne center, the which of it ſelfe is naturally immooueable: for as much as in it the reaſon of all heauynes conſiſteth. Wherby as otherwyſe, euery part that is mouued ſhould aſcend, contrary to the nature of all heauie thinges. But there is founde nothing heauie that dooth not naturally enclyne directly to the center of the earth, and woulde actually deſcende thyther, yf it had no impediment of ſome other thyng to reſyſt it: and when it toucheth there, or is come thyther, woulde ſtyll reſt and remayne there. And hereby it foloweth, that the earth, beyng founded vppon his owne center, is not mooued. The whiche thyng the Prophete Dauid alſo affyrmeth, ſaying, Fundaſti terram ſuper ſtabilitatem ſuam (that is) Thou foundeſt the earth vppon his ſtabilitie.

All heauie thynges encline to the center of the earth.

The earth is founded vpon his owne center

Pſal. Cxxx.

The. vii. Chapter, of the roundneſſe of the Earth and VVater.

The roundnes of the earth.

THAT the Earth is rounde, it appeareth by manifeſt euidence: For if it were playne or flatte, the dawnyng of the day or day ſpryng, ſhoulde equally and at one tyme appeare to them in the Weſt, as to them in the Eaſt. But we ſee the contrarie, that it appeareth fyrſt to them that dwell in the Eaſt, & afterwarde to them in the Weſt. This is prooued by the Eclipſe of the Moone, which begynnyng at one inſtant, they of Hieruſalem ſee it begin at foure a clocke of the night, and we of Andaluſie in Spayne, at one a clocke of the night. It foloweth hereby, that to them it nightereth three houres ſooner then vnto vs in Spayne: and this is cauſed by the roundneſſe of the Earth. It is alſo as well knowen to be rounde, from the pole Artyke, to the pole Antartyke: for by the roundneſſe thereof, is

The ryſing of the Sunne.

The Eclipſe of the Moone.

cauſed

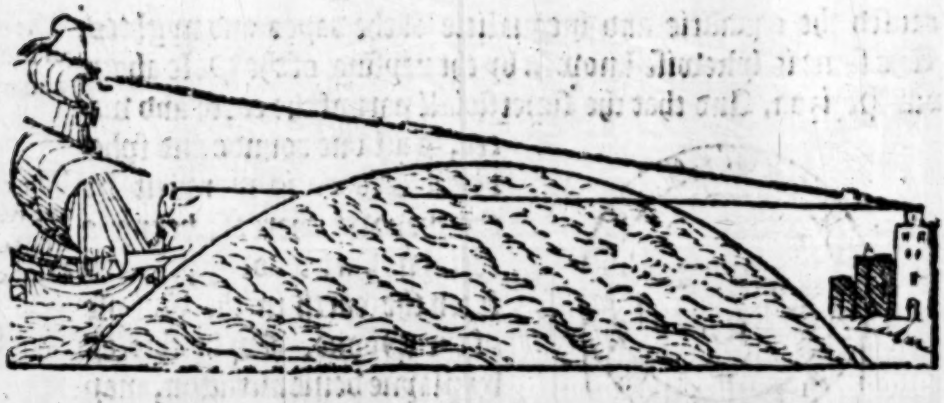
caused the equalitie and inequalitie of the dayes and nyghtes. The same is lykewise knowen by the rayſing of the Pole aboue our Horizon. And that the ſuperficiall part of the earth and water, is all one rounde and ſphericall Globe, is manyfeſt by the ſhadowe thereof, beyng a certayne darke body, reflected from the earth in the Eclipſe of the Moone. For by this, as by playne demonſtration, may we knowe that the earth is rounde, as may more manifeſtly appeare by this Figure. It is alſo prooued, that the water is a rounde body, as is ſeene by experience. For yf you erecte a marke vppon the Sea banke of a Porte, and a Shyppe departe from that Porte a certayne ſpace: then ſtandyng in the Poupe or Sterne of the Shyppe, you ſhall not ſee the marke afore layde: but yf you ſtande in the top of the Shyp, then may you ſee it. Whereas notwithſtandyng (yf that portion of the bendyng Arke of the earth, dyd not hynder the ſyght) you ſhoulde ſee it better beyng in the Poupe, for as muche as it is nearer to the marke then to the toppe of the Shyppe, as by this demonſtration folowyng, appeareth.



The equalitie of the dayes and nyghtes.

The earth and the water are one rounde Globe.

The water is a rounde body.



How the earth is round.

But here ſome may mooue a doubte, ſaying, that on the earth we may ſee many Mountaynes, and conſequently many great Vallyes and Playnes, with many diuerſities of ſundrie other deepe and vnequall places, by reaſon whereof, the earth can not truely be called rounde. To this I ſay, that in two maners, the earth is called and vnderſtoode to be rounde. As after one manner, ſpeakyng preciſely, it is called rounde, as a Circle or a Sphere, whiche we call rounde, becauſe that all ryght lines drawen from the center thereof to the circumference, are equall. The other roundneſſe, is conſydered without this preciſeneſſe: and is ſuche, as not by all his partes is equally diſtant from his myddeſt or center, but hath ſome partes hygher, and ſome lower, yet not in ſuch quantitie as may deſtroy the roundneſſe of the whole. As yf in a Bowle there were certayne clyftes or holes, it ſhould not thereby leaue to be rounde, although not perfectly or preciſely rounde. And for this cauſe ſayth Auerrois, that although both the heauenly bodyes & the Elementes are of round fourme, yet differ they in this, that the heauenly Spheres haue perfect roundneſſe, and the Elementes not. As the earth, by reaſon of his Mountaynes & Vales, the Sea by his encreaſing, and decreaſing, the Ayre alſo for his nearencſſe to the fyre, & by his contrarictie doeth ſometime doo, and ſometime ſuffer (that is to ſay) is ſometime actiue, and ſometime paſſiue. So that folowing the one, it fleeth the other, by reaſon whereof, it alſo lacketh perfect roundneſſe. But the fyre, for as muche as it is neare to the concaue of the circle of the Moone, which is Spherical, may therefore be called Sphericall or rounde.

The ayre is actiue and paſſiue, and not perfectly round

The fyre is round.

The

The. viii. Chapter, of the motion of the Heauens and Elementes.

IT is not to be forgotten, that all the Elementes are wholy mooueable by locall motion, except the earth. The water is mooued by the motion of the Moone, or tossed by the Wyndes. The fyre (as sayth Aristotle) is mooued circulerly by the motion of the day, and is drawen of the circles that embrace it, or compasse it about: as is manifest by the Cometes, or blasyng Starres, and other fyerie exhalations, conteined and engendred in it: Which being caryed with this motion, conclude, that the fyre mooueth in lyke maner. And with this motion is the superiour part of the ayre violently caryed about, as the other impressions therein do shewe. The inferiour part is mooued by diuers motions (that is to meane) laterally, as by experience we see when the wyndes blowe. The Moone with her Heauen or Spheare, by her proper motion geueth her turne from the West to the East, in. xxvii. dayes, and. vii. houres, with. xv. minutes. Venus, Mercuri, and the Sunne, in a yeere, which is the space of three hundred threescore and fyue dayes, with fyue houres, and fourtie and nine minutes. Mars in two yeeres. Iupiter in twelue yeeres. Saturne in. xxx. yeeres. The eyght heauen, which is the Fyrmament, or starrie Heauen, by his owne proper motion is mooued by the nienth Heauen, vpon the begynnyng of Aries and Libra, and vpon these two poyntes accomplysheth his Reuolution in seuen thousande yeeres.

How the fyre is mooued.

How the ayre is mooued.

The Moone.

Venus. Mercuri. The Sunne.

Mars.

Iupiter.

The starrie heauen or fyrmament.

This motion is called Motus trepidationis (that is to say) The Christalline heauen.

the tremblyng motion, or motion of acceſſe and receſſe. The nienth heauen endeth his motion from the Weſt to the Eaſt, in fourtie and viene thouſand yeeres: And by this motion moueth the eight heauen. The tenth heauen, called Primum mobile, is moued from the Eaſt to the Weſt: and in twentie and foure houres (whiche is a naturall day) perfourmeth one reuolution, and with the myghtie force and ſwyftneſſe of his motion, caryeth with hym all the other inferior heauens, and maketh them to geue the ſame turne in twentie and foure houres, where as neuertheleſſe they ceaſſe not in the meane tyme to keepe the courſe of theyr owne proper motion. As (for example) yf an Ant or Piſmire ſhoulde goe about the wheele of a Mylll, contrary to the mouing of the wheele: before the Ant in going fyrſt forwarde, ſhoulde come agayne to the poynt from whence ſhe fyrſt departed (whiche is onee about, or one turne) the wheele ſhoulde in that ſpace make many turnes.

First moueable.

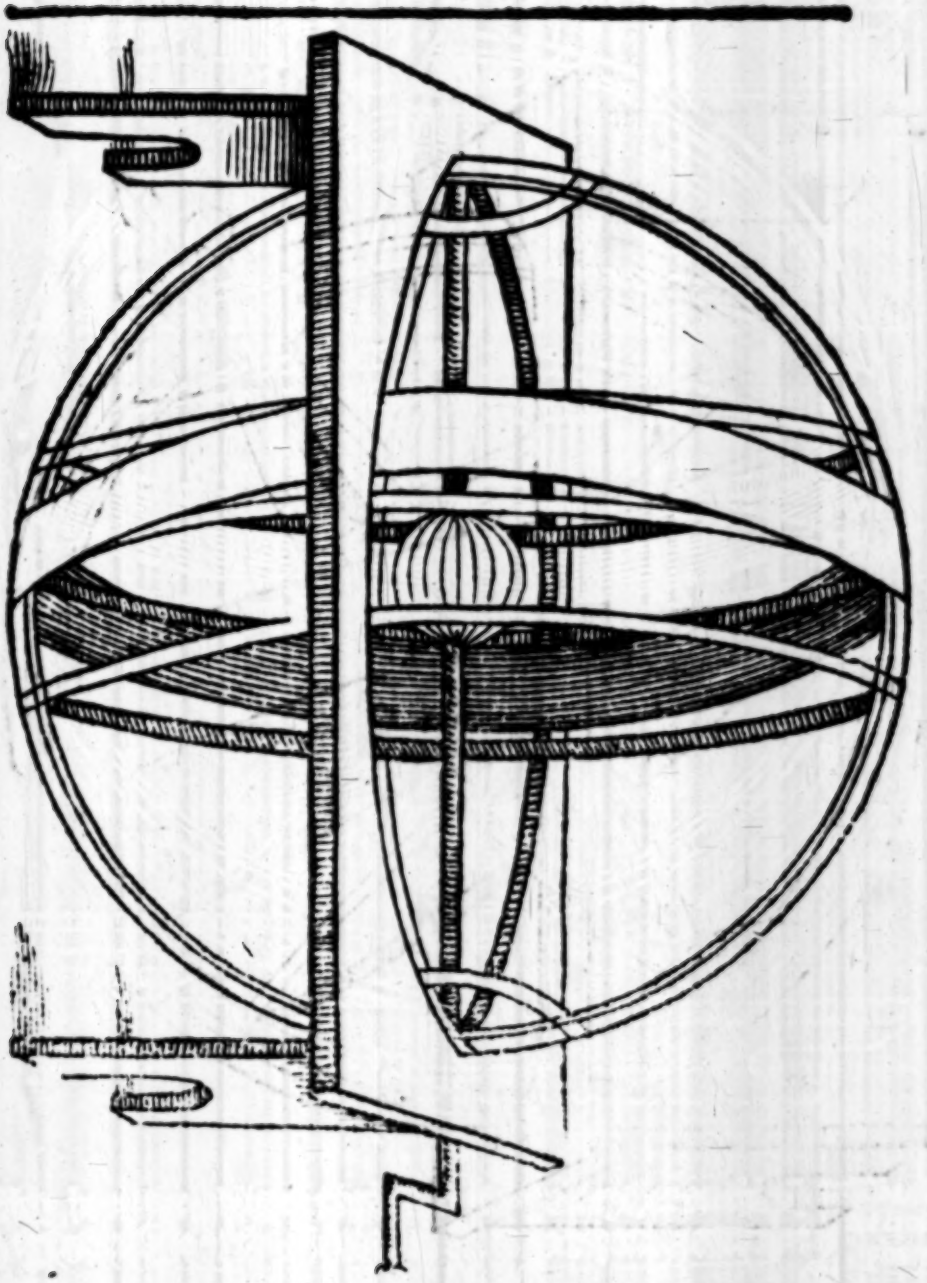
How the fyrſt moueable draweth the other heauens.

The. ix. Chapter, of the diuiſion of the Sphere into formall partes.

THE Sphere of the worlde, is diuided in two maners (that is to ſay) by ſubſtaunce, and by accident. By ſubſtaunce into teme Spheres, as we haue ſayde. By accident, into a right Sphere, and oblique or crooked Sphere. They haue ỳ right Sphere that dwell vnder the Equinoctiall lyne, and is called ryght, becauſe to them the Poles are equally in the Horizon, as appeareth by this Figure folowyng.

The ryght and crooked or oblique Sphere.

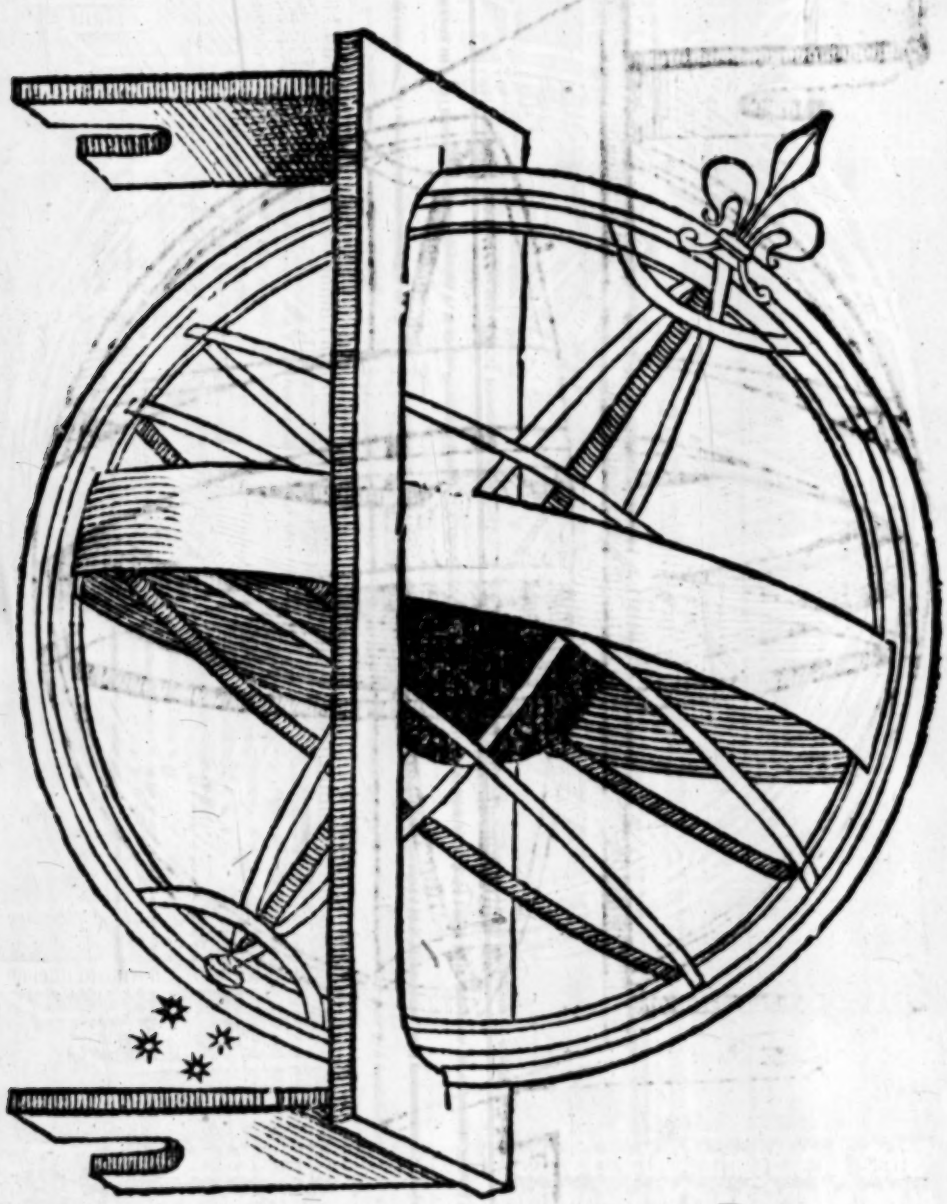
The



They haue the oblique Sphere that vseth either on the syde or the other syde of the Equinoctiall, vnto whom is euer one of the

The obliqne or croked Sphere.

the Poles aboue the Horizon, and the other vnder it, as appeareth in this Figure.



The x. circles of the Sphere.

The Sphere is compounded of tenne circles imagined. And (as ſayeth Iohn de ſacro boſco in his booke of the Sphere) lyte

of them are greater, and foure lesse. The greater Circle, is that which deuideth the Sphere into two equall partes, and hath his center with the center of it. These are the Equinoctiall, the Zodiacke, the two Coluri, the Horizon, and the Meridian. The lesse Circle, is that that deuideth the Sphere into two vnequall partes.

These are the two Troppykes, and two Poler Circles.

The. x. Chapter, of the Equinoctiall Circle.

THe Equinoctiall, is a Circle that deuideth the Sphere into two equall partes, and is by euery parte equally distaunt from both the Poles. It is one of the greater Circles in the Sphere, and is the greatest Circle of those whiche are described in the Sphere, by the motion of Primum mobile, or fyrst moueable. The Equinoctiall.

This Circle, for his equalitie, and regularitie, is more noble then the Zodiacke, which we haue described in the eyght sphere, and also then any of the other. It is imagined to gyrd the world round about by East and West. It is called Equinoctiall, because this worde Equinoctium, signifyeth equalitie of nyghtes and dayes, whereof the cause is, that the Sunne commyng to this Circle, the Arke of the day is equall with the Arke of the nyght, and then is the Equinoctiall. The equalitie of the day and nyght.

It is also called the Zone, or gyrdle of the fyrst mooueable. For euen as a gyrdle doth gyrde a man by the myddest, so doth this Circle gyrde in the myddest betweene both the Poles, vpon the which the fyrst mooueable is mooued. The fyrst moueable.

One of these imagined in our part of the Sphere, is called Polus Arcticus, because it is neare vnto certayne starres, which the Astronomers call Arctunus, whiche is the great Beare. It is called Septentrional, or Septentrion, because that round about it are mooued the. vii. starres, whiche make the lesse Beare, commonly called Bozina (that is, the The Pole Artyke.

The horne. North ſtarre.

horne. The ſtarre which is in the tayle of the leſſer Beare, is called the Noꝛth ſtarre, becauſe it is nearеſt vnto the Noꝛth Pole: the which Pole is a certayne poynt in the Firmament, which can not be ſeene, although the nyght be neuer ſo clеere. This Starre (as the Poet Homer ſayth) dooth moue lytle oꝛ nothyng, becauſe of his lytle diſtance from the Pole. The other Pole is imagined on the other contrary part, and is called Polus Antarticus, of the wooꝛde Ante, whiche ſignifyeth agaynſt, contray, oꝛ oppoſite, becauſe it is on the contrary parte from the Pole Artyke. It is alſo called the South Pole, becauſe that from that part of heauen commeth the Winde, commonly called the South: and is lykewyſe called Meridional, becauſe it is ryght South from vs. This is neuer ſeene to vs. They that dwell vnder the Equinoctiall, oꝛ come neare vnto this Pole Antartike, haue foꝛ a ſigne oꝛ marke to know it, foure Starres, in fourme of a Croſſe. And when the greateſt of theſe is loweſt in the foote of the Croſſe, they ſay it is. xxx. degrees aboue the Pole. And as we can not ſee theyꝛ Pole from hence, ſo they can not ſee our Pole from thence.

Pole Antartike.

The croſſe neare vnto the Pole Antartike.

The. xi. Chapter, of the Zodiacke Circle.

Zodiacke.

THE Zodiacke is deſined to decline oꝛ bende it ſelfe from the Equinoctiall. It is a great Circle, which deuideth the Sphere in two equall partes, cuttyng the Equinoctiall by oblique oꝛ crooked angles: So that beyng thus cutte oꝛ deuided by it into two equall partes, one part thereof declineth towarde the South, and the other towarde the Noꝛth. This Circle is called the Zodiacke, of this wooꝛde Zon, which in the Greke tongue ſignifyeth lyfe, becauſe that accoꝛdyng to the mooуyng of the Planets vnder it, is the lyfe of inferiour creatures: Oꝛ is ſo named of Zodion, which ſignifieth a lyuyng beaſt. And is therefoꝛe diuided into twelue

The twelue ſignes of the Zodiacke.

twelue equall partes, whereof euery part is called a ſigne, and euery ſigne hath an eſpeciall name of ſome beaſt, in reſpect of ſome propertie agreeable to the ſame: or for the order and diſpoſition of the fixt ſtarres in thoſe partes, ſomewhat repreſentyng the ſimilitudes of ſuche beaſtes, it is called zodiacke. The Latines called this Circle, Signifer (that is) the ſigne bearer, becauſe it carryeth theſe ſignes or images in it alſo, becauſe the twelue partes, into the which this Circle is deuided, are called the .xii. Signes. That part which declineth to the North, conteyneth .vi. Signes ſeptentrionall, and the other that declyneth to the South, conteyneth other .vi. called Meridionall. Furthermore, it is to conſyder, that the zodiacke may be deuided in two maners. One, by longitude or length into the .xii. ſignes aforeſayd, and euery ſigne is deuided into .xxx. degrees, which make .CCCIx. degrees, lykewyſe, euery degree is deuided into lx. minutes, and euery minute into .lx. ſecondes, and euery ſeconde into .lx. terces, and ſo to tenne. The other deuiſion of the zodiacke is, by latitude or breadth. By latitude it is deuided into .xii. degrees, and in it we imagine a lyne that deuideth his latitude by the myddeſt, hauyng .vi. degrees on euery part or ſyde. And this lyne, which deuideth into two equal partes the breadth or latitude of the zodiacke, is called the Eclyptike lyne, becauſe that when the Sunne and Moone are directly deuided vnder this lyne, eyther ioyned togeather by coniunction, or deuyded by oppoſition, then is the Eclipſe of the Sunne or of the Moone. Vnder this zodiacke the ſeuen planets are mooued. The Sunne alſo mooueth in the myddeſt of the ſayd zodiacke, alongeſt the Eclyptike lyne, not enclynyng more to the one part then to the other. But the other Planettes do ſometyme goe towarde the North, and otherwhyles toward the South, and ſometyme alſo towarde or trauerſe the Eclyptyke. It is lykewyſe to be noted, that theſe ſignes whereof we haue ſpoken, are not the conſtellations or ſtarres that make thoſe figures, which the auncient Aſtronomers dyd appropriate to certayne beaſtes, and other thynges: For theſe figures are mooued accordyng to the motion of the eight Sphere, and paſſe from one ſigne of the zodiacke to another. As we ſee that the Starre, called Oculus Tauri, that

How the Sun is cauſe of generation and corruption.

Deuiſion of the twelue Signes.

Deuiſion of the ſignes into degrees.

Deuiſion of the Zodiacke by latitude.

The Ecliptike lyne.

The mooving of the Sunne, and the other planettes in the Zodiacke.

The figures of beastes & other thynges imagined in heauen besydes the .xij. Signes.

(that is) the Bulles eye, is in two degrees of Gemini. And the two starres that are the head of Gemini, are in .xiii. and .xvi. degrees of Cancer. And Spica virginis (that is) the spyke of the Virgin, is in .xvi. degrees of Libra, and the hart of Scorpio in two degrees of Sagittarius. And by this order do they passe from one signe to another: so that we may not vnderstande the signes by these starres, but the .xii. partes of the Arke of the Zodiacke, takyng the begynnyng of the Equinoctiall of Aries. The names of these signes, with theyr Caractes and qualities, are described in this table here folowyng.

Numb.	Names	Characs.	Qualities.
1	Aries.	♈	Hot and dry.
2	Taur.	♉	Colde and dry.
3	Gemi.	♊	Hot and moyst.
4	Cancer.	♋	Colde and moyst.
5	Leo.	♌	Hot and dry.
6	Virgo.	♍	Colde and dry.
7	Libra.	♎	Hot and moyst.
8	Scorp.	♏	Colde and moyst.
9	Sagit.	♐	Hot and dry.
10	Capri.	♑	Colde and dry.
11	Aqua.	♒	Hot and moyst.
12	Pisces.	♓	Colde and moyst.

The .xii. Chapter, of the Circles called *Coluri*.

HEre are two circles in the Sphere, called Coluri, so named of the Greke woorde Colon, whiche signifieth a member: And of Vros, whiche signifyeth a tayle. Ore. The tayle of this beast, maketh a Semycircle, or halfe Circle, not perfecte. And as this beast mooueth his taile laterally or sydewayes,

and

and not by longitude: euen so do the Colure moue to vs, and are cut in vpright spherical Angles, vppon the Poles of the worlde. The one passeth by the Poles of the worlde, and by the poyntes of the Equinoctialles, and is called the Equinoctiall Colure: the other likewyse passeth by the Poles of the worlde, and also by the Poles of the Zodiacke, and by the poyntes of the Solsticialles, and is called the Colure Solstitiall, called Solstitium, as Solis statio (that is) the standyng or staying of the Sunne: because that when the Sunne commeth to this poynt, it declyneth no more, but turneth towarde the Equinoctiall. These circles deuide aswell the Equinoctiall, as the Zodiacke into foure equall partes, by the poyntes of the Equinoctialles, and Solstitialles. In the Colure Solstitiall, are the greatest declinations of the zodiacke, which are two Arkes of this Colure, contayned betweene the Equinoctiall and the zodiacke. And these Arkes are equall to the other two of the same Colure, included betweene the Poles of the worlde, and the Poles of the zodiacke.

The Equinoctial Colure.

The Solstitiall Colure.

The greatest declination of the Zodiacke.

The. xiii. Chapter, of the Meridian Circle.



The Meridian, is one of the great Circles, imagined to trauerse the sphere by the Poles of the worlde, cutteyng the same in two equal partes by the zenith or verticall poynt. It is called Meridiã for this effect, that whersoeuer a man becommeth, and at what soeuer tyme of the yeere, when the Sunne (by the mouing of the first moueable) shall come to his Meridian, to hym that it be high noone or myddaye, and is therefore also called the circle of the myddaye.

Definition of the Meridian Circle.

The myddaye or noone.

Diuers Meridians.

It is alſo to be noted, that there are as many Meridians, or Meridian lynes, as are differences or habitations by longitude: ſo that they that dwell in the Eaſt, haue other Meridians then they that dwell in the Weſt: So that the interpoſition of the arke of the Equinoctiall, betweene the Meridian of one Citie, and the Meridian of the other, is called the difference of longitude from one Region to another, and from one Citie to another, as we wyll further declare hereafter.

The. xiiii. Chapter, of the Horizontall Circle.

Definition of the Horizon.

THE Horizon (after the Aſtronomers) is a Circle whiche deuydeth that part of the heauen whiche we do ſee, from the other part whiche we ſee not, ſo that the ſayd Horizon deuideth the Sphere of the worlde into two equall halfes, called Hemiſpheres. The halfe which we do ſee, is called the Hemiſphere ſuperior, and it which we ſee not, is called the Hemiſphere inferior. This Horizon, chaungeth to them that moue: for as one doth moue, his Horizon doth chaunge. And hereof it commeth, that how many places are vpon the earth, and the circumference thereof, it is poſſible there ſhould be ſo many Horizons.

Hemiſphere or Horizon.

Diuers Horizons.

The Aſtronomers ſuppoſe the Horizon, after two maner of ſortes, that is to ſay, a ryght Horizon, and an oblique, or crooked Horizon. The ryght Horizon, is to them whoſe zenith or verticall poynt is directly in the Equinoctiall: and this ryght Horizon, paſſeth by the Poles of the worlde, and deuideth the Equinoctiall in ryght ſphericall angles. The other oblique or declyned Horizon haue they, vnto whom the Pole of the worlde doth ryſe aboue theyr Horizon. This Horizon is alſo called oblique, becauſe it deuideth the Equinoctiall in vnequall and oblique or crooked angles.

The ryght and oblique Horizon.

Alſo

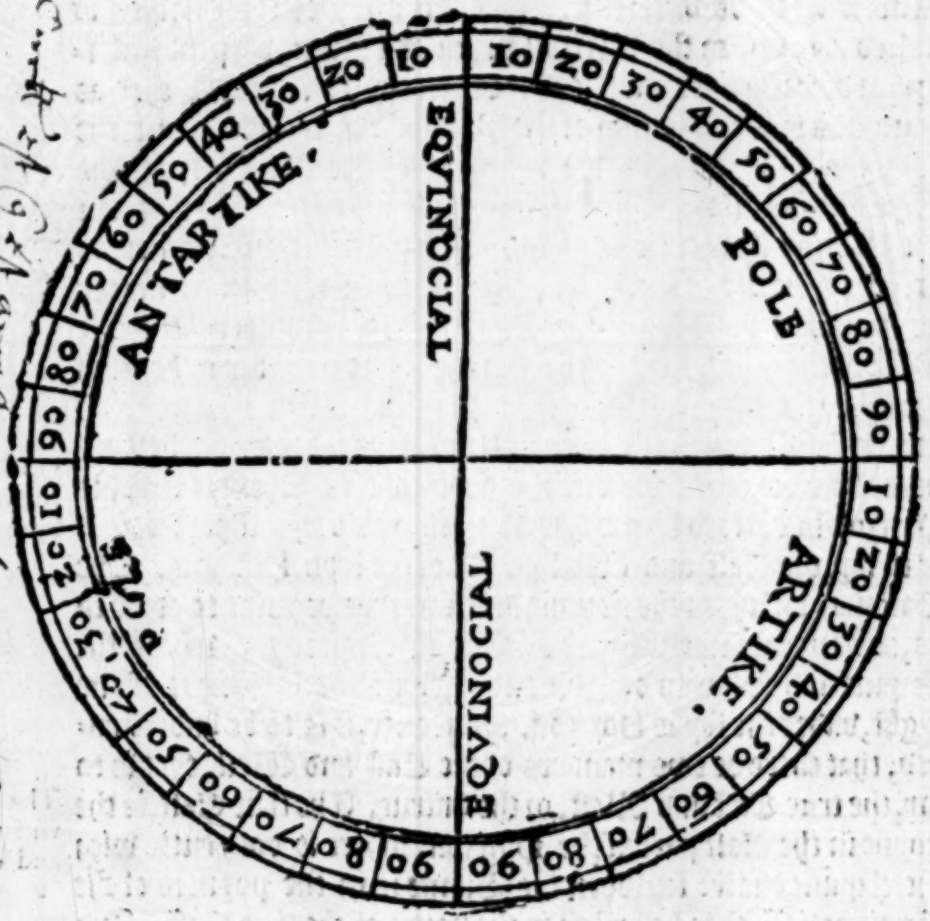
Also it is to be vnderstood, that the Pole of the Horizon is called Zenith, or the verticall poynt of heauen, perpendiculerlye, or directly ouer our head. Whereby is inferred, that as muche as is the eleuation of the Pole of the worlde aboue the Horizon, so muche is the distaunce of the Zenith from the Equinoctiall. For the Zenith by all his partes, is distaunt from the Horizon by nientie degrees. And all other impedimentes excluded, we may euer see halfe the heauen: And in as muche as any shall passe from the Equinoctiall, towarde the one Pole or the other, so much falleth the Horizon vnder or beneath the Pole, towarde the course he entendeth, and lykewyse as muche shall it be raysed aboue the contrary Pole, as shall appeare by a demonstration in the ende of this Chapter. This Horizon is diuided by the Meridian into two equall partes, that is to say, the East and West partes of the sayd Horizon. The East part is, where the Sunne and Starres beginne to aryse to vs, and appeare in our syght. The West part is, where the Sunne and Starres doth set and begyn to be hydde out of our syght, vnder the sayde Horizon. Moreouer, it is to be vnderstanded, that there be two manners of the East and West, that is to say, the true East and West, or the vntrue. The true East, is the poynt in the East part of the Horizon, where it doth cutte with the Equinoctiall: for when the Sunne is in the poyntes of the Equinoctiall, then he ryseth in the poynt of the true East. And lykewyse is to be vnderstande of the poynt of the true West, to be in the West part of the Horizon, where the Equinoctial doth cutte with the sayde Horizon. The vntrue East and West is variable, accordyng as the Sunne ryseth and setteth dayly in dyuers poyntes of the Horizon, which is distant from the poyntes of the true East and West, sometymes more to the Northward, and sometymes more to the South.

Distance of the Zenith from the Equinoctial

How the Horizon is diuided by the meridian

The true and vntrue East and West.

The



The.xv. Chapter, of the foure leſſe Circles.

The leſſe Circles.

HAuyng entreated of the .vi. biggeſt Circles, it remayneth to ſpeake of the foure leſſe Circles.

A leſſe Circle (as we haue ſayde before) is that, whoſe ſuperficiall diuydeth the Sphere into vnequall partes, not paſſyng by the Center thereof.

thereof. And of these, two are named Tropikes: so nemed of Trope the Greke worde, which significth *Conuersion*, because the Sunne commyng to any of these Tropikes, is conuerted, & turneth toward the Equinoctiall. These Tropikes are described by the motion of the fyrst moueable, with the poyntes of the Solstitials. The one with the begynnyng of Cancer, and this is called the Tropike of Cancer, or Estiuall, or Sommer Tropike: The other is described with the beginnyng of Capricorne, and is called the Tropike of Capricorne, or Hiemall, or Winter Tropike. These two Tropiks and the Polar Circles (whereof I wyl say more hereafter) are called Paralelles: so named, for that they are equally distant by their circumferences one from an other, as well as from the Equinoctiall. The Polar Circles are described in this maner: so that as the Zodiacke declineth from the Equinoctiall, so do the Poles of the Zodiacke decline from the Poles of the worlde. And as the eyght Sphere is mooued at the motion of the fyrst mooueable, so shall the Zodiacke moone, which is part of the Sphere. And the Zodiacke beyng mooued, his Poles shal lykewyse mooue aboue the Poles of the worlde. And as the Poles of the Zodiacke are distant from the Poles of the worlde. xxiii. degrees and a halfe (whiche is as muche as the greatest declynation) they shall describe certayne circles distaunt from the Poles of the worlde, in the selfe same. xxiii. degrees and a halfe. These Polar Circles, take theyr name or dominion of that Pole of the worlde that is most neare vnto them, and therefore is the one called Artyke, and the other Antartike.

Tropykes.

Paralelles.

The Polar Circles.

The Poles of the Zodiaeke, and Poles of the worlde.

The greateſt declination of the Sunne.

The Artyke, and Antartike.

* * *

The

The. xvi. Chapter, of the fyue Zones.

The Sphere diuided into fiue Zones.

THe ancient Astronomers diuided the Sphere vnto. v. Zones. The first, from the Pole Artyke, to the Circle Artyke. The second, from the Circle Artyke, to the Tropike of Cancer. The thyrde, from the Tropike of Cancer, to the Tropike of Capricorne. The fourth, from the Tropike of Capricorn: to the Circle Antartike. The fyfth, from the Circle Antartyke, to the Pole Antartyke. Of these fyue Zones, they haue certayne knowledge, that two of the Poles were vnhabitable for extreame colde: and also that the burnt Zone (called Torrida Zona) whereby the Sunne passeth by the middest of them, should be vnhabitable for extreame heate. That from the Tropike of Capricorne, vnto the Circle Antartyke, they called desart, because they knewe not that it was inhabited. And this our Zone, that is, from the Tropike of Cancer, to the Circle Artyke, they called inhabited or habitable. And to haue more perfect knowledge hereof, it is to imagine, that the earth is diuided proportionally into fyue Regions or Portions, which answeare directly to the sayde fyue Zones, as sayth the Poet Ouid in this Verse.

Zones habitable and vnhabitable.

The diuision of the earth accordyng to the fiue Zones of heauē.

Totidemque plagę, tellure præmuntur. (*That is*)
And so many Regions, are on the earth beneath.

Euery of these Regions or portions of the earth, is situate vnder one of the fiue Zones aforesayd. But whereas certayne men of auctholitie haue moued the question, whether the earth vnder the Zone, from the Tropike of Cancer, to the Circle Antartyke, is desart or no: Ptolomie and the Astronomers affyrme, that it is vnpeopled. But Aristotle, Ouid in the second of his *Metamorphoses*, Plinie also, and Iohn De Sacro bosco, affyrme the contrary: as for the more certaintie therof we know the experience of such as goe & come dayly from those partes. Moreouer then this, we knowe that that lande is not only well replenished with people of good corporature, & of white colour, but the same to be also very rych in Golde. For they that sayle to the East Indies, touche

An errour of Ptolome & the Astronomers.

touch in the cape of Buena ſperanza, or Caput bonæ Spei, which is in this Zone. Likewyſe the land of Braſile, and the confynes of Rio de la Plata, with all the coaſt, vnto the ſtraightes of Magalianes, euen vnto the. 54. degrees of the ſouth part. This land was diſcouered by Magalianes, in the yeere. 1520. or. 1521. wherby that is now wel knowen by ſight, whereof Ptolome had no knowledge by heare ſay. The burnt Zone (called Torrida zona) they alſo deſcribed to be vnhabitable, by reaſon of the great heate thereof, as Ariſtotle, Plinie, and in maner al other ancient auctors affirme: whereof the Poet Virgil wryteth thus.

The land of Braſile.

The ſtraightes of Magalianes.

Quinque tenent cælum zonæ, quarum vna corruſco.
Semper ſole rubens, & torrida ſemper ab igne.

Which in the Englyſhe tongue is thus much to ſay in effect.

In Zones fyue, the heauens conteyned be,
Whereof the one with burnyng Sunne is red:
Scorchyng the Earth ſubiect to his degree,
That for the heate thereof it is vnhabited.

Lykewyſe Ouide in his Metamorphoſes, toucheth the ſame, ſaying.

Quarum quæ media eſt, & torrida ſemper ab igne. &c.

Yet that the burnt Zone is inhabited, and well replenyſhed with people that lyue there, we knowe ſo certaynely by the number of them that dayly paſſe to and fro the Indies of your Maieſtie diſcouered, in your moſt happie dayes, that to ſay any thyng to the contrary, it ſhould be a manifeſt errour, & therfore is it greatly to be marueyled, that certaine wiſe men haue affirmed theſe partes to be vnhabitable: whereas neuerteleſſe they had knowledge of Arabia Foelix, Aethiopia, Taprobana, and dyuers other Regions ſituate vnder the burnt Zone. Plinie wryteth, that a ſhyppe came from the ſea of Percia by the Ocean, round about Ethiope, and came to the pyllers of Hercules, which is now the Citie of Cadiz, where at this preſent I write this briefe treatiſe. They of Guinea, Calicut, Gatigara, and Malaca, lyue all vnder the burnt Zone, and many of them lyue very long. And doubtleſſe, many thinges ought to perſwade vs, that vnder the burnt Zone, the earth is furniſhed with all thinges parteynyng to the lyfe of man: for that in that region, or portion of the earth, is in maner

The weſt Indies.

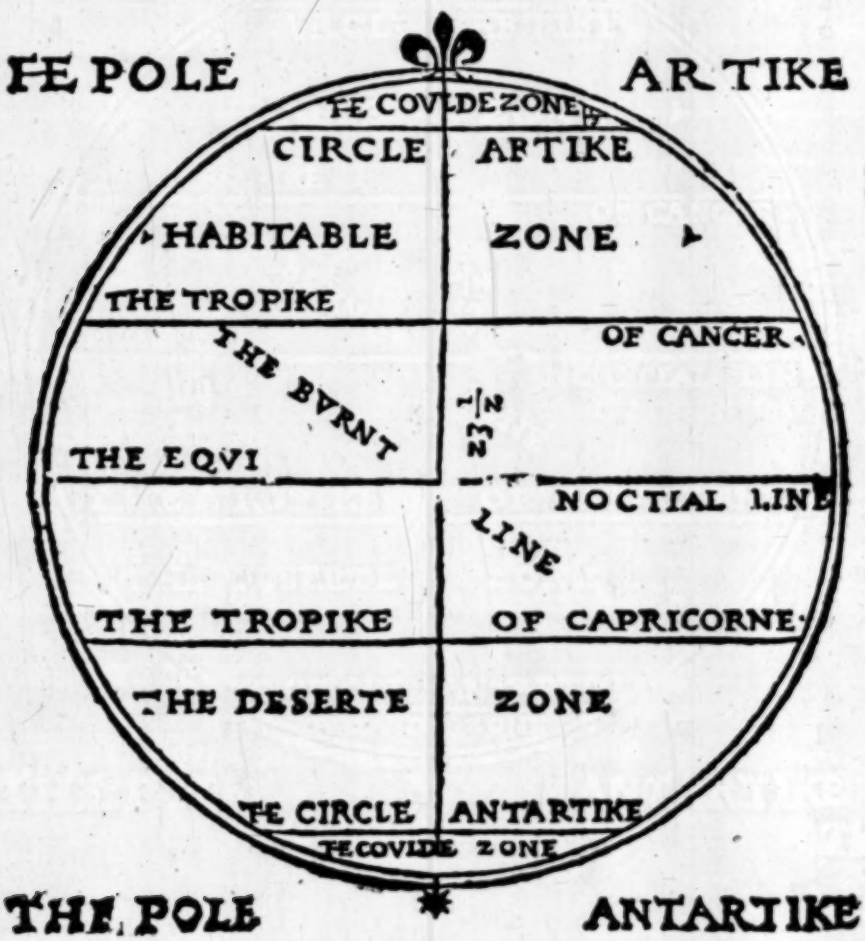
People of long lyfe vnder the Zone.

continual Equinoctial, and the colonesse of the nyght doth ſufficiently temper the heate of the day. Agayne, they that inhabite vnder that Zone, haue two Sommers, and two Winters in the yeere: whereby is concluded that the auncient aucthours erred, not onely in affyrmyng this Zone to be vnhabitable by reaſon of the great heate thereof, but in lyke maner erred, in affyrmyng the Zone that is betweene the circle Articke, and the pole Articke, to be alſo vnhabited by reaſon of great cold. The contrary whereof, we may well affyrme, knowyng as we knowe, that Iſlande, with part of Gothland, Norway, Ruſſia, and dyuers other Landes, are inhabited and well peopled.

Colde Regions habitable.

Iſlande.
Gothlande.
Norway.
Ruſſia.

¶ This is the figure and demonſtration which folowth.



The

The. xvii. Chapter, of longitude and latitude, and of the proportion which the lesse circles haue to the great circle.

The sphere or globe of the earth, is also dimmed in breadth, and in length. The breadth (which is called latitude) is by degrees: for from the Equinoctiall, to eyther of the two poles, is. 90. degrees. The length (whiche is called longitude) is by the degrees of the Equinoctiall, which is diuided in. 360. degrees. The fyrst degree of longitude, doth begyn at a certayne Meridian, which passeth by the Ilandes of the Canares, called the fyxed Meridian: and the order of the numbryng of the sayde longitude, is alwayes towarde the East. By euery degree of the sayd longitude in the Equinoctial, may be vnderstanded a great circle (called Meridian) to passe, eche one of them passyng and meeting the poles of the worlde, so that the sayd great circles, or meridians, doth diuide euery paralel or lesse circle, proportionally into. 360. degrees: but we must not vnderstande these degrees to be equall (that is to say) as great in one circle, as in another: for the greater the circle is, the greater is the degree in it: and the greater the paralel is, the nearer it is vnto the Equinoctiall lyne. Euery degree of the Equinoctiall, conteyneth in longitude 60. minutes, so lykewyse it is to be vnderstanded of the degrees of latitude, which be diuided ech one into. 60. minuts of latitude, because the degrees and minutes in the great circles, do not dyffer in theyr bygnesse the one from the other: but the degrees in the paralels, as they are distaunt from the Equinoctiall, and come neare to eyther of the two Poles, they diminyshe consequently, so that one degree in the paralel, of. 7. degrees of latitude, doth make in quantitie but. 59. minutes, and. 33. secondes of the Equinoctial circle: and to one degree in the paralel of. 12. degrees of latitude, goeth but. 58. minutes, and. 41. secondes of the Equinoctial, and to one degree in the paralel of. 16. degrees of latitude, there goeth. 57. minutes, and. 41. seconds.

The diuision of the Sphere by longitude and latitude.

The degrees of the Equinoctial circle.

The Table of minutes, which euery degree conteyneth in euery of the paralelles.

G.	M.	S.	G.	M.	S.	G.	M.	S.	G.	M.	S.	G.	M.	S.	G.	M.	S.
1	59	59	16	57	41	31	51	26	46	41	41	61	29	5	76	14	31
2	59	58	17	57	23	32	50	53	47	40	55	62	28	10	77	13	30
3	59	55	18	57	4	33	50	19	48	40	9	63	27	14	78	12	28
4	59	51	19	56	44	34	49	45	49	39	22	64	26	18	79	11	27
5	59	46	20	56	23	35	49	9	50	38	34	65	25	21	80	10	25
6	59	40	21	56	1	36	48	32	51	37	46	66	24	24	81	9	23
7	59	33	22	55	38	37	47	55	52	36	56	67	23	27	82	8	21
8	59	25	23	55	14	38	47	17	53	36	7	63	22	29	83	7	19
9	59	16	24	54	49	39	46	38	54	35	16	69	21	30	84	6	16
10	59	5	25	54	23	40	45	53	55	34	25	70	20	31	85	5	14
11	58	54	26	53	56	41	45	17	56	33	33	71	19	32	86	4	11
12	58	41	27	53	28	42	44	35	57	32	41	72	18	32	87	3	8
13	58	28	28	52	59	43	43	53	58	31	48	73	17	33	88	2	5
14	58	13	29	52	29	44	43	10	59	30	54	74	16	32	89	1	3
15	57	57	30	51	58	45	42	26	60	30	0	75	15	32	90	0	0

The. xviii. Chapter, of the circuite or compasse of the *Earth and Water, according to the opinion of the auncient and latter authours.*

IT may here appeare to be necessarie for our purpose, to declare what space of the superficie of the earth or water, the auncient wryters did suppose to aunsweare to one degree of a greater circle in the heauen: for in diuers countries, they vsed to count by dyuers sortes or maner of measures: as, the Latines counted by myles, the Grekes by furlonges, the Spanyardes and Frenchmen by leagues, the Egyptians by signes or markes, and the Persians by

Myles.
Furlonges.
Leagues.

by saguas. But they al agree, that foure graines of Barly make a finger breadth, foure fingers, a hande breadth, foure handes a foote, fiue foote, a Geometrical pase (for two simple pases, make fiue feete.) Also. 125. Geometrical pases, make a furlong, eyght furlonges, one myle, whiche is a thousande pases: and three myles, one league. In Germanic they make leagues of more sorte, and in some places more then in other. In Fraunce, they count thyrtie leagues, to one degree. The Spaniardes, count sixteene leagues and two tercos, and seuenteene and a halfe for a degree of the great circle: this difference that one league is bigger then another, may come hereof, that one Barly corne is bigger then another. But to our purpose, let vs geue to euery league three thousand pases, and to euery pase fyue foote, and so shall euery league haue .xv. thousande foote. In the Cardes of the sea, that haue their degrees of .xvi. leagues and two tercos, we say, that of these, the roundenesse of the lande and the water conteyneth sixe thousande leagues. And in the Cardes that haue seuenteene leagues and a halfe for a degree, of these we say that it conteyneth sixe thousande and three hundred leagues. And who so desyreth to knowe howe muche is the Diameter of the earth and water, may know it by multiplying the circumference by seuen, so that diuiding the summe that riseth thereof by twentie and two, the part that ryseth of that calculation, shalbe the Diameter: and the halfe thereof, shalbe the semidiameter.

Grayne. Fynger. Foote. Pase. 125

The degrees of the sea Cardes.

The diameter of the earth and water.

The .xix. Chapter, of the seuen Climates.

THE auncient aucthours dyd also diuide that part of the superficie of the earth, on the Northside of the Equinoctiall, whiche they supposed to be most habitable, into seuen Climates, wherein they dyd fynde to be diuers conditions and customes of men, and diuersities of beastes, and of other natural thynges: the which

Diuision of the earth and water by Climates.

Diuersities of thynges in diuers Climates.

thynges they perceyued to haue a diuerſitie in the countreys, as where the day of the one dyd encreaſe or differ aboue the day of the other by halfe an houre, ſo that the ſpace of the ſuperficiall of the earth betweene two paralelle lynes, wherein the longeſt day doth increaſe or differ by halfe an houre, is called a Climate. The place where they ſuppoſe the fyrſt climate to begin, is diſtant in Latitude from the Equinoctial by. 12. degrees. and. 45. minutes, where the longeſt day is. 12. hours, and. 45. minutes, & the place where the laſt climate doth finiſhe, is in the Latitude of. 50. degrees, and. 30. minutes, where the longeſt day is. 16. hours, and 15. minutes, ſo that the increaſe of the longeſt day in the ende of the ſeuenth climate, dooeth exceede it in the begynnyng of the fyrſt climate by three houres and an halfe: and the whole compaſſe of the earth, with al the ſeuen climates, dooeth conteyne in breadth. 37. degrees, and. 45. minutes, but their length is ſuppoſed to extende to. 180. degrees of longitude. In that maner, a climate, the neare it is vnto the Equinoctial, the more it conteyneth of the ſuperficiall of the earth, becauſe the paralelle circles, the nearer they be vnto the Equinoctial, the greater is the compaſſe of the earth whiche they make in length, and the leſſer the compaſſe is, the nearer they be vnto the poles, as dooth appeare euidently by the Meridians, where they doo all concurre, and meete in the poles, theyr diſtaunces waxeth continually leſſer and leſſer, the nearer they be vnto the ſayde poles, ſo that the nearer the climate is vnto the pole, the leſſer it conteyneth of myles in the length. In lyke maner ſhall you vnderſtande, that greater is the breadth of the firſt clime, then of the ſeconde, and the ſeconde then the thyrde, and lykewyſe of the other. For in howe muche the more the Equinoctiall you come neare to the pole, ſo muche the more is the Sphere oblique or crooked, and conſequently the day encreaſeth more: by reaſon wherof, in leſſe ſpace is founde the increaſeth of halfe an houre, in whiche the climate maketh difference and doth varye. Whiche thyng ſhall be more manifeſt to hym that beholdeth the Latitude of them all, as may appeare by the Table here folowyng: In whiche you may ſee the houres whiche the greateſt day conteyneth of euery climate in his begynnyng, middeſt, and ende,

What is a climate. Difference dayes.

The ſpace of ſeuen climates

The quantitie of the leſſe circles.

The Latitude of Climates

ende, with also the elevation of the Pole, or distaunce from the Equinoctiall, and also the degrees of Latitude, which euery Climate conteyneth.

	The longest day.				The elevation of the pole.				Differences	
Climates.	Beginning.		Midd.	End.	Beginning.		Midd.	End.	of y latitude	
	Ho.	M	Ho. M	Ho. M	G	M	G	M	G	M
1	12	45	13 0	13 15	12	45	16 40	20 30	7	45
2	13	15	13 30	13 45	20	30	24 15	27 30	7	0
3	13	45	14 0	14 15	27	30	30 45	33 40	6	10
4	14	15	14 30	14 45	33	40	36 24	39 0	5	20
5	14	45	15 0	15 15	39	0	41 20	43 30	4	30
6	15	15	15 30	15 45	43	30	45 24	47 15	3	45
7	15	45	16 0	16 15	47	15	48 40	50 30	3	15

The fyrst Climate, is called Dia Meroes, Meroe is a Citie of Aphrike, vnder the burt Zone, on this side the Equinoctiall, 16. degrees. *Dia Meroe.* 1

The second, is called Dia Siena, Siena is a Citie in the confines of Ethiope, where there is a well that sheweth the Sommer solsticiall, because that place is vnder the circle of the Tropike of Cancer, and the Sunne seemeth to stande directly ouer that place at mydday of the solsticiall, whereby the well is then very cleere, and hath in it no shadowe at all: as the Poet Lucan maketh mention in Farsalia, where he sayth. *Dia Siena.* 2

Vmbras nusquam flectentes.

That is to say, Shadowes no where reflectyng.

The thyrde is, Dia Alexandros. Alexandria is a fameus Citie in Aphrike, buylded by great Alexander, and is the cheefe Citie or Metropolis of Egypt. *Dia Alexandros.* 3

The fourth is, Dia Rhodos. Rodes is an Ilande of Asia the lesse, where were some tyme the Knyghtes of the Rhodes, called the Knyghtes of the order of Saint John, or Knyghtes of Hierusalem, who were dryuen from thence, when the Ilande and Citie was taken by Solton Suliman the great Turke, in the yeere. 1522. Philippe Vilerio Frenche- *Dia Rhodos.* 4

Knighes of the Rhodes.

The Rhodes taken by the Turke.

man, beyng then graunde Maister of the Rhodes. Within this fourth Climate, is the Citie of Hierusalem, within the holy land called Palestina, and also a great part of Spayne, with many other Prouinces.

5 Dia Romes. The fyfth, is Dia Romes. Rome is the most famous Citie of Italie, and most notorious of all Europe, sometyme the head of the worlde, dominatrix of Nations, and now the See of the Bishop of Rome.

6 Dia Boristhenes. The syxth, is Dia Boristhenes. Boristhenes is a great Riuer of Scithia, the fourth arme of the riuer Istro. It falleth into the sea Euxinum: and where as all other riuers of Scithia are troubled, this is cleere and fayre, also holesome to be drunke, and full of Fyshes.

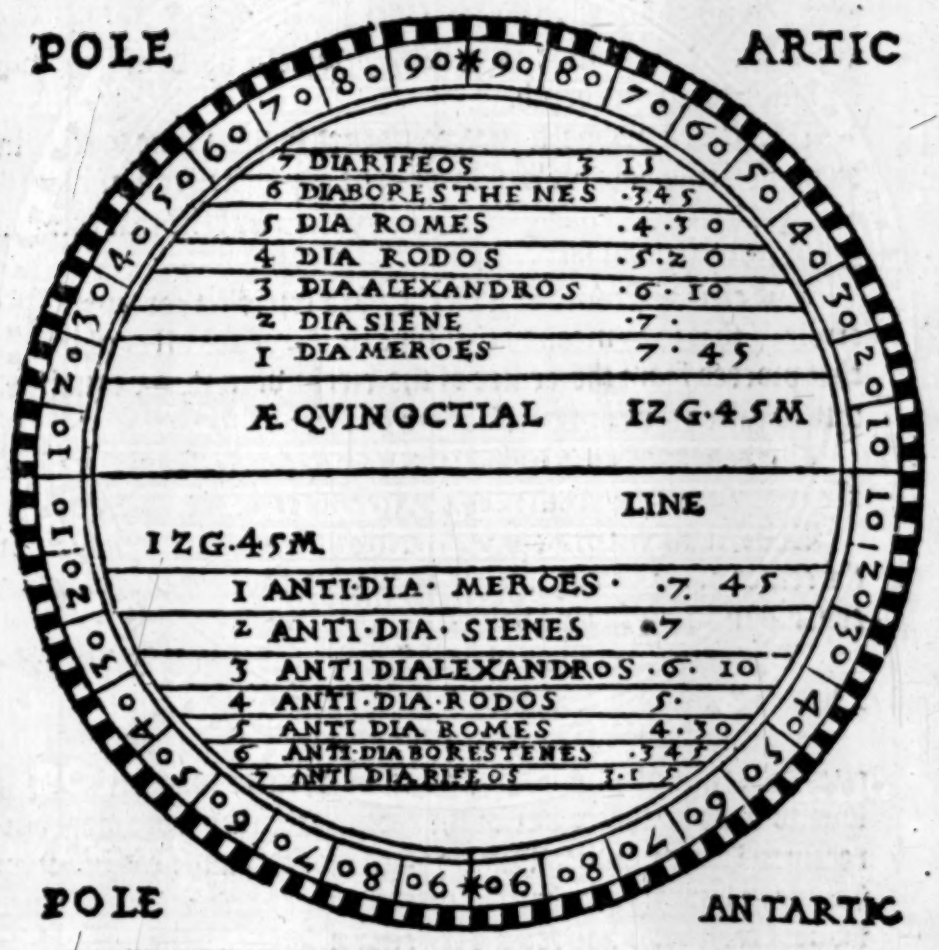
Dia Rifeos. The seuenth, and last Climate, is called Dia Rifeos. The Mountaynes called Rifei, are famous in the part of Europe called Parmatia, and are continually couered with Snow. Out of these, syngeth the riuer Tanais, well knowen in the worlde by fame. When it is wrytten with ph it is the name of certayne Mountaynes of Archadia. And here ought we not to be ignoraunt, that whereas the aucthours assigned onely seuen Climates, they myght haue made many more. And for that they iudged the part of the Pole Antartyke not to be inhabited, they assigned no Climates thereto. Stoflerine added the eygth Climate, countyng from the ende of the seuenth Climate, vnto. 57. degrees: and other added more. In lyke maner describyng Meridionall or South Climates, we call them by the selfe same names, as we dyd the aforesayd Septentrionall, or North Climates: sayeng that it is necessarie to put before euery of them this Greke proposition Anti, which in the Latine tongue signifieth Contra, or Contrarium (that is) contrary, or agaynst. So that as we named the fyrst North Climate, Dia Meroes, we must to the fyrst of the South, adde this worde Anti, and so shal the fyrst South Climate be named Anti Dia Meroes: The seconde, Anti Dia Sienes, and so forth of the other, as is seene in the Figure here folowyng.

The riuer Tanais.

Stoflerine.

The Meridian or South Climate.

The



The.xx. Chapter, of certayne principles, that ought to be knowen for this science.

IN treating of the Sphere, we haue spoken of Circles, Circumferences, Centers, Diameters, Lynes, with suche other wordes, appropriat to this science: The whiche, what they are, it is conuenient further to declare.

A ryght lyne, is a shoyt extention from poynt to poynt. A right line.

An angle, is the touchyng of lynes in one superficiall, whose An angle.

whoſe touch ſhall not be direct : for if it be, it ſhalbe a lyne, and not an angle. Solide is a body, whiche by deuiſions hath length, breadth, and depth.

Solide.

A circle is a playne figure, conteyned vnder a lyne drawne in compaſſe, in whoſe middeſt is a poynt or pricke, from the which al ryght lynes comming forth to the circular lyne that compaſſeth it about, are equal.

A circle.

The circumference of a circle, is a lyne that conteyneth the circle, (that is to meane) that lyne to the which all ryght lynes that proceed from the center of the circle vnto it, are equal: and this is called the roundneſſe of the circle.

The circumference of a circle.

The center of a circle, is that poynt or pricke from the which al ryght lynes proceeding vnto the circumference, are equal.

The center of a circle.

Diameter. The Diameter of a circle, is a ryght lyne, whiche paſſing by the center of the circle, and extendyng his endes to the circumference, diuideth it in two halfes.

Semicircle. The halfe circle, is a playne figure, conteyned between the Diameter of the circle, and the halfe circumference.

Zenith. Zenith, is a poynt or pricke imagined in the heauen, directly ouer the toppe of any thyng, as if we ſhoulde imagine a ryght lyne to paſſe by the center of the earth, extended from thence directly to heauen, and paſſing thyough the feete and head of a man ſtandyng vpryght, ſo that the extremities or endes of this lyne, ſhould reach vnto and touche the circumference of heauen: then the imagined poynt or pricke of heauen, where the ende of the lyne toucheth, is called Zenith, or poynt of the head, or vertical poynt. The ſame is to be vnderſtoode of a citie, or any other thyng, when we ſpeake of the zenith thereof.

Eccentricke. Eccentricke, is a circle, which hath his center diſtant, or diuided from the center of the worlde, and is deſcribed in the heauen of the Sunne, imagining a lyne from the center of the Eccentricke, to the center of ỳ Sunne, making a complete reuolution at the proper motion of the Sunne, in the other heauens, imagining a lyne from the center of his Eccentricke, to the center of his Epicicle, and beyng mooued a whole reuolution at the proper motion of the Epicicle.

The

The Epicicle, is a circle, or litle rundell fyxt in the deapth of the Eccentricke: in whiche the Planet fyxed, and neare to his center, is mooued circularly. *Epicicle.*

The Auge, is a poynt in the circumference of the Eccentricke, neareſt vnto the firmament: or it may be ſayde, that the Auge is a poynt fardeſt diſtaunt from the earth. Aux in the Greeke tongue, is as muche to ſay, as the greateſt longitude, or greateſt eleuation from the earth. The Oppoſite of Auge, is an other poynt in the circumference of the Eccentricke, neareſt vnto the earth, and fardeſt diſtant from the firmament. *Auge.* *Oppoſite of Auge.*

¶ Here endeth the firſt part.

The ſeconde part, intreating of the *Motions of the Sunne, and the* Moone, and of the effectes cauſed thereby.

The fyrſt Chapter, of the courſe of the Sunne in the Zodiacke, and the effectes cauſed by the ſame.

WE haue briefly ſpoken of the Sunne and of the other heauens. But for as muche as the Sunne muſt bee our marke, guyde, & gouernour in Nauigation, whereof we intend to geue perfect inſtructions, it ſhalbe neceſſarie eſpecially, and precisely, to declare the courſe and motions thereof. Therefore (as we haue ſayd) the Sunne is mooued vnder the Zodiacke, and vpon his poles in the lyne Eclipticke, paſſing by the xii ſignes, begynnyng in the fyrſt degree of Aries, where he maketh. *The Sunne is the guyde in Natigation.* *The mooving of the Sunne vnder the Zodiacke.*

keth Equinoz, that is to ſay, he maketh the day equal vn-
to the nyght in al places. Then from Aries, he entreth and moo-
ueth into Taurus, approching nearer and nearer vnto vs on the
Noꝛth part, whereby the length of the dayes are increaſed with
vs, and the nyghtes are ſhoꝛtened. Then entreth he into Gemi-
ni, and from Gemini into Cancer, where in the begiñing of
the firſt degree he maketh Solſtice, and toucheth the Sommer
The Sommer Tropicke. oꝛ Eſtiuall Tropike, and then are the dayes longeſt with vs,
Declination of the Sunne and the nyghtes ſhoꝛteſt. Then declineth he no farther from the
Equinoctiall: but returnyng towarde it, paſſeth by this ſigne,
ſhoꝛtenyng the dayes to vs, and lengthenyng the nyghtes.
From this ſigne of Cancer, it entreth into Leo, and paſſeth by it
into Virgo, and by it entreth into the firſt degree of Libra, where
he is in the Equinoctial, and then he maketh the other Equinoz,
ſo that the nyght is then equall vnto the day ouer all the woꝛlde.
And paſſyng by this ſigne, goeth declynyng from the Equinoc-
tiall towarde the pole Antartike, increaſyng the nyghtes to vs,
and ſhoꝛtenyng the dayes: and ſo entreth into Scoꝛpio, and
from thence into Sagittarius. And paſſyng by it, entreth in-
Teh Winter Tropike. to the fyrſt degree of Capꝛicoꝛne, to the Hyemall oꝛ Winter
Tropike: and then are the longeſt nyghtes vnto vs, and the
ſhoꝛteſt dayes. From hence he returneth towarde the Equi-
noctiall, ſhoꝛtenyng vnto vs the nyghtes, and lengthenyng the
dayes. He paſſeth by this ſigne of Capꝛicoꝛne, and entreth into
Aquarius: and paſſyng by it, entreth into Piſces: and paſſyng
The cauſe of increaſing and decreaſing of the day and nyghtes. from thence, returneth to his fyrſt poynt of the Equinoctiall of
Aries, where he began. Hereby it foloweth, that as the Sunne
goeth the halfe of the zodiacke on this paꝛt of the Equinoctiall,
and the other halfe on the other paꝛt of it, and in theſe halfes hath
diuers declinations, is cauſed the increaſing oꝛ decreaſing of the
dayes and nyghtes, to one moꝛe, and to another leſſe, accoꝛdyng
as euery one with his Hoꝛizon diſcoucreth of the courſe of the
Sunne, by the lytle oꝛ muche that he is departed oꝛ diſtant from
the Equinoctiall, oꝛ as the pole is rayſed aboue his Hoꝛizon.
So that when as to them that are on this paꝛt of the Equinoc-
tiall, is the longeſt day and the ſhoꝛteſt nyght: euen ſo to them

on

on the other part, is the longeſt nyght, and ſhorteſt day. And contrarywyſe, when vnto vs is the ſhorteſt day, vnto them is the longeſt, which ſhall further appeare by euident demonſtration in the laſt Chapter of the thyrde part.

The diſcrecte Reader ſhall here note, that the Sunne is not mooued regularly in the Zodiacke, makyng ſo much by his proper motion in one day, as in the other, becauſe his reguler motion is in reſpect of the center of his owne proper ſphere or orbe wherein he is mooued, whoſe center is diſtaunt without the center of the worlde, toward that part of Cancer, ſo that the greater part of his orbe eccentricke, is towarde the ſeptentrionall part, where the Sunne paſſyng by the ſeptentrionall ſignes, is more diſtant from the earth, and hath more to goe of his orbe eccentricke, then being in the South ſignes: for paſſyng by the North ſignes, he taryeth nyne dayes more, to diſcribe that halfe of the Zodiacke, then the other halfe towarde the South part, and for that cauſe the Sunne is more ſwyfter in his motion in the Zodiacke one tyme then another, for his motion in one day in the South ſignes, ſhalbe greater then it is in one day in the North ſignes, as ſhall appeare in the table that foloweth: whoſe vſe is, for the fyndyng of the motion and true place of the Sunne in the Zodiacke for euery day of the yeere. And hereby it foloweth of the ſayd vnequall mouyng of the Sunne, and by the obliquite of the Zodiacke, certayne dayes of Winter, with their nyghtes, are longer then certaine other of Sommer, with their nyghtes: that is to ſay, that the day naturall in the Winter, doth ſurmount that in the Sommer, becauſe the ryght aſſenſion, which anſweareth to one dayes motion of the Sunne, beyng in the South ſignes, is greater then the aſſenſion for one dayes mouyng, beyng in the North ſignes.

The mouyng of the Sunne in the center of his Sphere.

The

The. ii. Chapter, of the true place of the Sunne in the Zodiacke.

To fynde the true place of the Sunne.

The true place of the sunne is a poynt or pycke in the Zodiacke, whiche is thus founde: that drawyng a ryght lyne from the center of the worlde, to the center of the sunne, and carying the same continually right forth vnto the Zodiacke, where this lyne sheweth or toucheth, that is the true place of the Sunne. This place is found in three maners. One way, by a table: another way, by an instrument: and the thyrde way, by a certayne rule, to be borne in memorie. To fynde the true place of the Sunne by a table, seeke in the table folowyng, the moneth that you are in, in the front or head of the table, and the dayes of the moneth, on the left syde of the table. Then directly agaynst the dayes, vnder the litle of the monethes, you shall fynde two numbers, which are the degrees and minutes of the signe which you shall fyrst fynde, named ouer the head, or aboue the sayd numbers. Then to the degrees and minutes which you shal fynde, you shal adde the equation, that is directly of the yeere in the which you are, or seeke to knowe. And this shall you seeke in the table of equations, which is after this: and that which doth amount or ryse thereof, shalbe the true place of the Sunne. And here is to noted, that in the common yeeres (whiche are they that haue not the bisextile or leape yeeres) from the ende of Februarie, vntyll the ende of the yeere (I say of December) shall euer one degree be diminished or taken away: and the degrees and minutes that shall remayne, is the true place of the Sunne. How to know this by an instrument and by memorie, shalbe sayd in the seuenth Chapter.

The equasion of the yeere.

The Table of the true place of the Sunne.

Months.	January.		Febuary.		Marche.		Appyll.		May.		June.	
Signes.	Caprico.		Aquarius.		Pisces.		Aries.		Taurus.		Gemini	
Dayes.	☉	☽	☉	☽	☉	☽	☉	☽	☉	☽	☉	☽
1	20	22	21	53	20	55	21	24	20	21	19	55
2	21	24	22	54	21	55	22	22	21	18	20	52
3	22	25	23	54	22	54	23	21	22	16	21	49
4	23	26	24	55	23	54	24	19	23	11	22	46
5	24	27	25	55	24	53	25	17	24	13	23	43
6	25	28	26	56	25	53	26	16	25	8	24	40
7	26	30	27	56	26	52	27	14	26	6	25	37
8	27	31	28	56	27	52	28	12	27	3	26	34
9	28	32	29	57	28	51	29	10	28	0	27	31
10	29	33	☉♓	57	29	50	☉♉	8	28	58	28	28
11	☉♒	35	1	57	☉♈	49	1	6	29	55	29	25
12	1	36	2	58	1	48	2	4	☉♊	52	☉♋	22
13	2	37	3	58	2	47	3	2	1	50	1	19
14	3	38	4	58	3	46	4	0	2	47	2	16
15	4	39	5	58	4	45	4	58	3	44	3	13
16	5	40	6	58	5	44	5	56	4	41	4	10
17	6	41	7	58	6	43	6	54	5	38	5	7
18	7	42	8	58	7	42	7	52	6	36	6	4
19	8	43	9	58	8	41	8	49	7	33	7	1
20	9	44	10	58	9	39	9	47	8	30	7	58
21	10	45	11	58	10	38	10	45	9	27	8	55
22	11	46	12	58	11	37	11	43	10	24	9	52
23	12	47	13	57	12	36	12	40	11	21	10	49
24	13	48	14	57	13	34	13	38	12	18	11	46
25	14	48	15	57	14	33	14	36	13	15	12	43
26	15	49	16	56	15	32	15	33	14	12	13	40
27	16	50	17	56	16	30	16	31	15	10	14	37
28	17	51	18	56	17	29	17	28	16	7	15	34
29	18	51	19	56	18	28	18	26	17	4	16	31
30	19	52			19	27	19	23	18	1	17	29
31	20	52			20	25			18	58		

The Table of the true place of the Sunne.

Monthes.	July.		August.		Septēber.		October.		Nouēber.		Decēber.	
Signes.	Cancer.		Leo.		Virgo		Libra.		Scorpio.		Sagittari	
Dayes.	☉	☽	☉	☽	☉	☽	☉	☽	☉	☽	☉	☽
	°	′	°	′	°	′	°	′	°	′	°	′
1	18	26	18	2	18	4	17	39	18	49	19	24
2	19	23	19	0	19	2	18	39	19	50	20	26
3	20	20	19	58	20	1	19	38	20	51	21	27
4	21	17	20	55	21	0	20	38	21	52	22	29
5	22	14	21	53	21	58	21	38	22	53	23	30
6	23	11	22	51	22	57	22	38	23	54	24	31
7	24	8	23	48	23	56	23	38	24	55	25	33
8	25	5	24	46	24	55	24	38	25	56	26	34
9	26	2	25	44	25	54	25	39	26	57	27	36
10	27	0	26	42	26	53	26	39	27	58	28	37
11	27	57	27	40	27	52	27	39	28	59	29	39
12	28	54	28	38	28	51	28	39	♑	0	♒	40
13	29	51	29	36	29	50	29	39	1	1	1	42
14	♌	48	♍	34	♎	49	♏	39	2	3	2	43
15	1	46	1	32	1	48	1	40	3	4	3	45
16	2	43	2	30	2	47	2	40	4	5	4	46
17	3	40	3	28	3	46	3	40	5	6	5	48
18	4	38	4	26	4	45	4	41	6	8	6	49
19	5	35	5	24	5	45	5	41	7	9	7	51
20	6	32	6	22	6	44	6	42	8	10	8	52
21	7	30	7	21	7	44	7	42	9	11	9	54
22	8	27	8	19	8	43	8	43	10	12	10	55
23	9	25	9	17	9	42	9	43	11	13	11	57
24	10	22	10	16	10	42	10	44	12	14	12	58
25	11	20	11	14	11	41	11	45	13	15	13	59
26	12	17	12	13	12	41	12	45	14	16	15	1
27	13	15	13	11	13	41	13	46	15	18	16	2
28	14	12	14	10	14	40	14	47	16	19	17	3
29	15	10	15	8	15	40	15	47	17	20	18	5
30	16	7	16	7	16	39	16	48	18	22	19	6
31	17	5	17	5			17	49		23	20	7

The Table of the Equation of the Sunne.

The yeres of our lord	The equatiō to be added.		The yeres of our lord	The equatiō to be added.		The yeres of our lord	The equatiō to be added.		The yeres of our lord	The equatiō to be added.	
	☉	☽		☉	☽		☉	☽		☉	☽
1545	R1	0	1581	1	16	1617	1	32	1653	1	48
1546		45	1582	1	1	1618	1	17	1654	1	33
1547		30	1583		46	1619	1	2	1655	1	18
1548		15	1584		32	1620		47	1656	1	3
1549	1	2	1585	1	18	1621	1	33	1657	1	49
1550		47	1586	1	3	1622	1	18	1658	1	34
1551		32	1587		48	1623	1	3	1659	1	19
1552		18	1588		33	1624		49	1660	1	4
1553	1	4	1589	1	19	1625	1	35	1661	1	51
1554		49	1590	1	4	1626	1	20	1662	1	36
1555		34	1591		49	1627	1	25	1663	1	21
1556		19	1592		35	1628		51	1664	1	7
1557	1	05	1593	1	21	1629	1	37	1665	1	53
1558		50	1594	1	6	1630	1	22	1666	1	38
1559		35	1595		51	1631	1	7	1667	1	23
1560		21	1596		37	1632		53	1668	1	9
1561	1	7	1597	1	23	1633	1	38	1669	1	55
1562		52	1598	1	8	1634	1	23	1670	1	40
1563		37	1599		53	1635	1	8	1671	1	25
1564		23	1600		39	1636		54	1672	1	10
1565	1	9	1601	1	25	1637	1	40	1673	1	56
1566		54	1602	1	10	1638	1	5	1674	1	41
1567		39	1603		55	1639	1	10	1675	1	26
1568		25	1604		40	1640		56	1676	1	12
1569	1	11	1605	1	26	1641	1	42	1677	1	58
1570		56	1606	1	11	1642	1	27	1678	1	33
1571		41	1607		56	1643	1	12	1679	1	28
1572		26	1608		32	1644		8	1680	1	13
1573	1	12	1609	1	28	1645	1	44	1681	R2	0
1574		57	1610	1	13	1646	1	29	1682	1	45
1575		42	1611		58	1647	1	14	1683	1	30
1576		28	1612		44	1648	1	0	1684	1	15
1577	1	14	1613	1	30	1649	1	46	1685	2	2
1578		59	1614	1	15	1650	1	31	1686	1	4
1579		44	1615	1	10	1651	1	16	1687	2	32
1580		29	1616		46	1652	1	2	1688	1	8

This Table of the Equation of the Sunne, serueth from the yeere of. 1545. where it hath his roote or beginning, vntil. 1680 and in the yeere of. 1681. it shall returne to the roote, adding thereunto one degree more. As for example. In ỳ yeere of. 1681. adde one degree vpon the other degree that the roote hath, and so shal the yeere of. 1681. haue two degrees of Equation, and the yeere of. 1682. shall haue one degree, & .45. minutes, which is to adde one degree vpon. 45. minuts, that had the yere of. 1546. &c. And hauing passed other. 136. yeeres, you shall returne to the roote, addyng two degrees.

The. iii. Chapter, of the declination of the Sunne.

What is the declination of the Sunne.

THE declination of the Sunne, is the arcke of the greater Circle, which passeth by the Poles of the worlde, included betweene the Equinoctiall and the Zodiacke. And here is to be noted, that whatsoeuer foure poyntes or pickes which are equally distaunt from the poyntes of equinoxes (which are the begynnynges of Aries and Libra) shall haue equall declinations.

Whereof it followeth, that the foure quarters of the Zodiacke haue equal declinations. And to auoyde prolixitie, I wyll adde hereunto a Table of the declinations of onely one quarter of the zodiacke, so that al hauing one selfe same maner of declinations, it may serue for all, and the order of it is this. The signes whose declination increaseth, are in the head or fronte of the Table, and the degrees of these signes descend by ỳ left side thereof. And the signes whose declination decreaseth, are in the foote of the table, and the degrees of these signes, rise by the right side of the same. The disposition of the table beyng vnderstoode: then to knowe what declination the Sunne hath in euery degree of the Zodiacke, you ought to know the true place of the Sunne (as in the

Chapter

Signes	♈	♎	♉	♏	♊	♐	Signes
♑	♑	♋	♑	♋	♑	♋	♑
0	0		11	30	20	12	30
1	0	24	11	51	20	25	29
2	0	48	12	12	20	37	28
3	1	12	12	33	20	49	27
4	1	36	12	53	21	0	26
5	2	0	13	13	21	11	25
6	2	23	13	33	21	22	24
7	2	47	13	53	21	32	23
8	3	11	14	13	21	42	22
9	3	35	14	32	21	51	21
10	3	58	14	51	22	0	20
11	4	22	15	10	22	9	19
12	4	45	15	28	22	17	18
13	5	9	15	47	22	25	17
14	5	32	16	5	22	32	16
15	5	55	16	23	22	39	15
16	6	19	16	40	22	46	14
17	6	42	16	57	22	52	13
18	7	5	17	14	23	57	12
19	7	28	17	31	23	3	11
20	7	50	17	47	23	8	10
21	8	13	18	3	23	12	9
22	8	35	18	19	23	15	8
23	8	58	18	34	23	19	7
24	9	20	18	49	23	22	6
25	9	42	19	4	23	24	5
26	10	4	19	18	23	26	4
27	10	26	19	32	23	28	3
28	10	47	19	46	23	29	
29	11	9	19	59	23	30	1
30	11	30	20	12	23	30	0
Signes	♌	♏	♒	♌	♑	♋	Signes

Chapter paste is declared) for the day of the declination which you desyre to knowe, and the signe whiche the Sunne shall be found in that day, shal you seeke in the front or foote of the Table. And yf it be in the fronte, you shall seeke the number of the degrees on the left syde. And if it shalbe at the foote of the table, you shall seeke it on the ryght syde. Then aboue or vnder ỳ signe, in the front of that degree of the said signe, you shall fynde two numbers, whereof the first is of degrees, and the second of minutes: and those degrees & minutes of declination the Sunne hath ỳ day. And this is vnderstoode without hauyng respect to the od minutes aboue the degree, whiche the true place of the Sunne hath.

And yf you desyre to verifie this more precisely, note the declination of that

degree, and of the degree folowyng: and take the lesse from the more, and that which remayneth, shalbe the difference of the declination from the one degree to the other, of which difference ye shal take a part proportionally, as are the minutes of the place of the Sunne vnto. 60. And this part of minutes must be added to the fyrst declination of it, and be lesse then the seconde, or must be taken from it yf it shalbe greater, and then that riseth therof, shalbe the precise declination for that signe, degree, and minute. As for example. In the yeere. 1546. the tenth day of September, the Sunne shalbe in. 26. G. 38. ♍. of Virgo, & to the. 26. G. precise, shall correspond. 1. G. 36. ♍. of declination. And to verifie the declination that commeth to. 38. minutes, whiche is more of the. 26. G. you must marke the difference that is from the declinatiō of. 26. G. (which is one. G. 36. ♍.) to the declination of the 27. G. which is 1. G. 12. ♍. The difference is. 24. ♍. Of these you must take such part proportionally, as the. 38. minutes beareth vnto. 60. which are almost two terces of a degree. Then the two terces of. 24. are. 16. which must be taken from one degree. 36. ♍. which correspond to the. 26. G. of Virgo, because the declinations goe decreasyng, and remayneth. 1. G. 20. ♍. and if the declinations increase, you must adde thereto, as you take away when they decrease.

An other example for this yeere of. 1561.

Example for the yeere. 1561. the. 20. of Apryll, I fynde the true place of the Sunne at noone, in. 9. degrees. 54. minutes of Taurus: then in the Table of the signes present, I secke for. 9. degrees of Taurus, to whiche doth answeare for the declination. 14. degrees. 32. minuts, & to the next degree folowyng, doth answeare. 14. degrees. 51. minutes: then take the lesser out of the more, so resteth. 19. minuts. Then from a rule of. 3. & say, if. 60. minutes geue. 54. minutes (which. 54. minuts doth rest before of the. 9. degres of Taurus) how many doth. 19. minuts geue? whiche. 19. minuts are the diuersitie of the. 9. & . 10. degrees of Taurus. So I finde, that. 19. minutes geueth. 17. minutes, & . 6. secondes, which. 17. minutes, & . 6. secondes, I adde to the. 14. degrees. 23. minuts, which answeareth to ỹ. 9. degrees of Taurus.

And

And it commeth to fourteene degrees. 49. minutes, and syxe secondes, which is the true declination for the twentie day of Aprył. Anno. 1561.

It is also to be noted, that I adde these seuenteene minutes and sixe secondes, because the declination doth encrease: for if it decreased, it were to be taken out so much, and the rest is the declination. So is the declination for the twentie of Aprył in the yeere. 1561. fourteene degrees. 49. minutes, and syxe seconds.

The. iiii. Chapter, of the encrease of the Sunne into the twelue Signes. And of the Equinoctials and Solstitials which deuide the foure tymes of the yeere.

IF that is sayd in the Chapter before, it foloweth that the sunne entring into the foure principall signes, causeth the foure tymes of the yeere. For entryng into Aries, it chaungeth the tyme to vs from winter to the sprýng tyme. And entryng into Cancer, it chaungeth the tyme from sprýng to sommer. And entring into Libra, from sommer to Autumne. Lykewyse entring into Capricorne, it chaungeth from Autumne to Winter. So that when to vs that be on the part of the Nǫrth, is sommer, then is it winter to them that are on the South part. Dǫ contrarywyse, beyng sommer to them on the South, it is winter to them on the Nǫrth. The entrance of the sunne into these signes, and al other of the Zodiacke, hath not been euer at one selfe same tyme of the yeere. The cause of this is, that the Latine yeere is not equall with the mouyng of the sunne in the Zodiacke, as shalbe sayd in the. x. Chapter, where we wyl entreate of the yere. In the tyme that Christ our redeemer was borne, were the Equinoctialles. The one at the eyght of the kalendes of Aprył,

The entraunce of the Sunne into the foure principall signes.

The Latine yeere.

The Equinoctialles in the yeere of Christes byrth.

and the other at fyue of the kalendes of October: So that they had the Equinoctiall of the Spryng, at the. xxv. of Marche, and the Equinoctiall of Autumne, at the. xxvii. of September, as wryteth Iohn Baptist Capuano vpon the seconde Chapter of the sphere of Iohan. De sacro bosco. They iudged then the Solsticialles, as that of the Sommer, at the eyght day of the kalendes of July, which is the. xxiiii. of June: the other of the Wynter, they iudged at the eyght day of the kalendes of Ianuarie, which is the. xxv. of December. And here wyll I not omit to say how in those tymes, at these foure dayes (that is to meane, in the two Solstitialles and two Equinoctialles) were celebrated, or dyd chaunce foure marueylous thynges in the worlde. For in the spryng Equinoctial, which was at the. xxv. of March, the Sonne of GOD was incarnate, and afterwarde borne of the Virgin Marie in the Solstitiall of Wynter, whiche was at the. xxv. of December. In the Equinoctiall of Autumne, whiche was the. xxvii. of September, was conceyued blessed Iohn Baptist, the cryer and precursour of Christe: and was borne in the sommer Solstitiall, that was the. xxiiii. of June. And this is the syxth Moneth whereof Saint Luke speaketh in the Gospell. Whiche thyng also Iohn Chrisostome doth verifie, saying that Saint Iohn was borne when the dayes beganne to decrease, and our Lorde when they began to increase. And it may certaynely seeme worthy to be had in memorie, that in the sayde Equinoctiall of the spryng, Christe suffered, Adam was created and loste the estate of innocencie, Abel was slayne, Melchisedech offered breade and wyne, Isahac by Abraham was brought to be sacrificed, Iohn Baptist was beheaded at Macherunta, Peter delyuered out of Pryson, Saint Iames beheaded by Herode, the good Theefe enioyed Paradise, and the bodyes of many Saintes rose with Christe. And who so further desyreth more precisely to knowe the entraunce of the Sunne into Aries, and into the other principall signes, shall in the thyrde parte of this worke in the eyght Chapter, fynde rules whiche shall bryng hym to the knowledge thereof.

The Solstitials.

Foure notable thynges.

To know more precisely the entraunce of the Sunne into the foure principall signes.

thereof. But to returne to our tyme, I say that this present yeere of. 1545. the Sunne entreth into the fyrst degree of Aries, at the tenth of Marche, at foure of the clocke at after noone, and into the fyrst degree of Taurus the nynth of Appyl. 2. houres, and. 7. minutes, and into Gemini the. 11. of May. 2. houres and syxe minutes, into Cancer the. 11. of June. 14. houres. 44. minutes, into Leo the. 13. of July. 3. houres. 50. minutes, into Virgo the. 13. of August. 9. houres. 56. minutes, into Libra the. 13. of September. 4. houres. 4. minutes, into Scorpio the. 13. of October. 7. houres. 13. minutes, into Sagittarie the. 12. of Nouember iust at noone, into Capricorne the 11. of December. 8. houres. 16. minutes, into Aquarius the. 9. of Januarie. 2. houres, one minute, into Pisces the. 8. of Febyuarie. 1. houre. 30. minutes after mydday (that is to say) from noone. 1. houre. 30. minutes. And that we may in the yeeres to come, knowe the day, houre, and minute, in the whiche the Sunne entreth into euery signe, we wyll folowe this order. Upon the dayes, houres, and minutes, that the Sunne entreth into euery signe this sayde yeere. 1545. we must adde for euery yeere fyue houres and. 49. minutes, which with the. 365. dayes, which euery yeere conteyneth, shalbe the tyme in the which the Sunne accomplysheth his Reuolution. And because that in the yeere of the Bisextile or Leape yeere, is added to Febyuarie one day more to his. 28. which he hath once in foure yeeres, from. 6. to. 6. houres, yf we shall take from the computation that whiche we haue geuen hym, turnyng one day backwarde (as shalbe in the yeere. 1548.) and vppon that that remayneth shall returne in the yeere folowyng of. 1549. to adde fyue houres. 49. minutes, and as much more euery other yeere folowyng, shalbe a certaine rule for euer.

To know when the Sunne entreth into euery of the. xij. Signes.

Leape yeere.

And it is to note, that the degrees and minutes whiche we haue touched before, are properly for the Citie of Cadiz. And yf we desyre to applye them for other Cities or places more Eastwarde: then for euerye. xv.

degrees that they are distant fram Cadiz in longitude, we must adde one houre. And yf for Cities, or places more Westwarde, in lyke maner for euery. xv. degrees we must take away one houre, by reason of the course of the Sunne by his rapte mouing from the East to the West. For it is certayne, that when with vs in Cadiz it is. xii. houres of the clocke, to them that are. xv. degrees Eastwarde from vs, it is one of the clocke, and to them that are from vs. xv. degrees towarde the West, it is. xi. of the clocke.

Variation of houres by the rapte mouing of the Sunne from the East to the West.

Now that we haue Rules to knowe the entraunce of the Sunne into the. xii. signes, thereby may we also knowe his entraunce into the foure Cardinall or principal signes, which are they that determine and ende the Equinoctialles and Solstitialles, whereby are caused the foure tymes of the yeere. And forasmuch as the generall chaunge of tymes, is by reason of the Sunne, who by his commyng neare, warmeth, by his remaynyng, dryeth, with his departure, cooleth, and by his long taryng away, causeth moystnesse, we wyll shew the qualities of the principall wyndes, elementes, regions, humours, and ages, in one briefe Table: and then consequently in an other wyl we describe the beginning, myddest, and ende of the foure tymes of the yeere, aswell in the monethes, as in the heauenly signes.

The entraunce of the Sunne into the. iiii. principall signes, causeth the chaunge of tyme.

The table of the qualities of the Elementes.

Qualities.	Hot & dry	Hot & moyst	Cold & moist	Cold & dry
Partes of the yere	Sommer	Spryng.	Winter.	Autumne.
Principal windes	East.	South.	West.	North.
Elementes.	Fyre	Ayre.	Water.	Earth.
Regions.	East.	South.	West.	North.
4. Humours.	Choler.	Blood.	Flegme.	melãcholy
4. Ages.	Youth.	Mans state.	Aged.	Age.

The

The Table of the foure tymes of the yeere.

Tymes.	Beginnyng.		Myddeſt.		Ende.	
Spryng.	Marche.	Aries.	Apryl.	Taurus.	May.	Gemini
Sommer.	June.	Cancer.	July.	Leo.	Auguſt.	Virgo.
Autumne.	Septemb.	Libra.	Octob.	Scorpio.	Nouemb.	Sagit.
Wynter.	Decemb.	Capricor.	Janua.	Aquar.	Febrya.	Piſces.

The. v. Chapter, of the Moone, and of her motions and properties.

IN the Chapters paſt of this ſeconde part, we haue entreated of the Sunne, and of his motions and effectes, as the moſt noble and principall luminarie. In this preſent Chapter we wyl entreate of the Moone, which is the ſeconde luminarie, although in the order of the heauens ſhe is the fyrſt, and nearest vnto vs of al other Planets or ſtarres. The Moone therfore is a roumde body, of heauenly ſubſtaunce, ſolide and darke in reſpecte of the Sunne, hauing no proper lyght of his owne, but is apt to receyue lyght. She is mooued from the Weſt into the Eaſt, according to the order of the ſignes, euery day. 13. degrees litle more or leſſe, and ſomewhat more then. 10. minutes, by the proper motion of the heauen or ſphere vpon the Axes & Poles of the Zodiacke. I ſayd more or leſſe, becauſe that ouer and beſide the mooving of her deferent or circle, which is moued euery day the aforeſayd. 13. degrees & .10. minutes, almoſt. 11. ſhe hath an Eclipſe where the Moone is fixed: at the motion whereof, ſomtimes ſhe is moued more ſwiftly, & ſometimes more ſlowly: Neuertheleſſe, according to her ſelfe motion, ſhe maketh her courſe in. 27. dayes & almoſt. 8. houres: and hauing no lyght of her owne, ſhe is lyghtened of the Sun, as manifeſtly appeareth hereby, that beyng in coniunction with the Sunne, or neare vnto hym, we ſee her not lyghtened: becauſe the lyght whiche ſhe then receyueth, is onely her vppermoſt or hygheſt parte, whereby ſhe directly beholdeth the Sunne, forasmuche as he is in

The Sunne and Moone are the principal luminaries.

The Eclipſe of the Moone.

The coniunction of the Moone with the Sunne.

The Moone receiueth her lyght of the Sunne.

in the fourth heauen, and she in the first. And departing from the Sunne by her proper mouyng, the Sunne remayneth on the West part. Then towarde that part we begyn to see a lytle of the part of the Moone lyghtened, and so more and more by lytle and lytle, as she departeth farther from the Sunne. And at this tyme she hath her hornes or corners towarde the East, because the Sunne is in the West. During this time also, she is sayd to increase, or that she goeth increasing vnto the oppositiõ which we see, by the part of her, which the Sunne directly beholdeth. And so do we see her altogeather lyghtened, and call it the full Moone. Then passyng from the oppositiõ, she commeth nearer the Sunne by lytle and lytle, beyng darkened and hyd from vs, and lyghtened onely by her hyghest part: and this time is called the decreasing or wane of the Moone. Then also hath she her hornes towarde the West, because the Sunne is in the East: and this vntyl she turne againe in coniunction with the Sunne, and that we see her not lyghtened at all.

The aspecte of the Moone to the Sunne.

The increasing & oppositiõ of the Moone.

The Moone is lesse then the starres or other planets, except Mercurie, and lesse then the earth. And yf any shall affirme the contrary, saying that it is wrytten in the fyrst of Genesis, that God made two great lyghtes: the greatest to geue lyght to the day, and the lesse to lyghten the nyght (as Dauid also affirmeth.) To this I answeare, that the Moone beyng nearest vnto the earth, appeareth vnto vs greater then she should do, yf she were further distaunt from vs. And although she be great of lyght (receyued as we haue sayd) & bygge of body, yet is she not great in respect of the other starres. And therefore the wordes of Genesis aforesayd, may be vnderstode to be spoken in such maner and phrase as holy Scripture often vseth, to humble and applye it selfe to the weakenesse of our vnderstandyng, and grosenesse of our senses.

The bygnes of the moone.

The Moone is nearest vnto the earth.

The. vi. Chapter, of the coniunctions and oppositions of the Sunne and the Moone.

The



The Sunne and the Moone are moued vnder the Zodiacke with diuers motions. The Moone with a swifter motion then the sunne soloweth him, ouertaketh hym, and goeth before hym, vntyll she place her selfe in Diameter with him. And when she hath thus ouertaken him, so that they are both in one selfe same degree of the Zodiacke, then is the coniunction. Then departyng from hym, and beyng in equall degrees of the signes opposite accordyng to the Diameter, is the opposition. To knowe the tymes of these coniunctions and oppositions, is very profitable and necessarie for Mariners. These tymes may be knowen in two maners. One way, by the Ephimerides or Almanacke, or other tables, or Lunarie instrumentes. And by these meanes is knowen precisely the day, houre, and minute of the coniunction and opposition. It may lykewyse be knowen by the rules of computation, whiche are the rules that are knowen by memorie, although not precisely, as by the bookes aforesayd. And here is to be vnderstoode, that from one coniunction to another, accordyng to the halfe mooueynges of the Sunne and the Moone, there passeth. 29. dayes, twelue houres, and. 44. minuts. And consequently from coniunction to opposition, and from opposition to coniunction, the halfe thereof, which is fourteene dayes. 18. houres, and. 22. minutes. To know these coniunctions by rules of computation, is presupposed to know the golden number, and by it, the concurrent or Epacte.

The motion of the Moone.

The coniunction.

The opposite.

To know the tymes of oppositions and coniunctions.

The golden number, is the number of nineteene yeeres. In which tyme, the coniunctions of the Sunne and the Moone make al their varieties in the tymes of euery yeere: so that yf the coniunction were the twelfth day of Marche in this yeere of 1545. from this yeere in the nineteene yeeres folowyng, which shalbe in the yeere of. 1564. the coniunction shall returne to be at the twelfth day of Marche. It was fyrst called the golden number by the Egyptians, who fyrste founde the vse thereof, and sent it to Rome wrytten in golden Letters. To fynde this

To know the golden number

The rootes of the golden number.

this number, it is needefull to know his rootes, which is this. In the yeere that Christ our Lorde and redeemer was borne (whereby we make this accompt) the golden number was the number of one, which was the yeere of the roote or begynnyng: and the fyrst yeere of the byrth of Christ, was two of the golden number. So that ioynyng to the yeeres of our Lorde one of the roote or beginnyng, and from all take away the nienteene, then the rest shalbe the golden number. And yf you desyre to make computation by a nearer roote, take for the roote the yeere of 1500. when nienteene was the golden number, and in the yeere of. 1501. did begin one of the golden number, and so consequently euer takyng away the nienteene.

This present yeere of. 1545. we haue seuen of the golden number. And in the yeere of. 1546. we shall haue eyght. &c.

The concurrent.

The golden number being knowen, it is necessarie for this computation of the Moone to knowe the concurrent. The concurrent of euery yeere, is the number of the dayes passed of the coniunction of the Moone at the beginnyng of Marche. And these growe of the difference of the Solar yeere to the Lunar:

The Solar and Lunar yeeres.

As the Lunar yeere hath. 354. dayes, and the Solar yeere. 365. so hauyng euery yeere eleuen dayes of difference, which are added euery yeere vntyll they come to the number of thyrtie, and passyng thyrtie, those that do passe are of the concurrent.

To fynde the number of the concurrent.

The number of the concurrent of euery yeere, is founde in this maner.

And the better to beare it in memorie, you must imagine three places: and these commonly are assigned on the thumbe. As the fyrst place at the roote of the thumbe, the seconde in the myddle ioynt thereof, and the thyrde and last, in the toppe of the thumbe. Then in the fyrst place put tenne, in the seconde twentie, and in the thyrde thirtie. Then by the order of these places shalbe compted the golden number: As one in the fyrst place, two in the seconde, and three in the thyrde, returnyng foure to the fyrst place. &c. vntyll the golden number of that yeere for the which the concurrent is sought. And the number of that place where the golden number endeth, must be ioyned with the number of the golden number: and that dooth

amount

amount thereof, shalbe the concurrent, so that it passe not. 30. But if it passe. 30. then that that is more then. 10. is the concurrent of that yeere.

And here is to be noted, that the yeeres of this computation of the Moone, begin at the first day of March, and last vntyl the last day of Februarie, so that this present yeere of. 1545. by computation of the golden number, we haue seuen: which accompted by the sayd places, endeth in the first, which is 10. which also ioyned with the golden number of seuen, make. 7. and so much is the concurrent of this present yeere.

Likewyse, this number of Epacte, or concurrent, is found in multiplying the golden number by. 11. & deuiding the summe by. 30. then that remayneth, is the Epact or concurrent. Epact.

The concurrent beyng thus knowen, then to know the dayes of the Moone, it is necessary to know three numbers. The fyrst, is the concurrent. The seconde, the number of the moneth in which you are, begynnyng at March. The thyrde, the dayes past of the same moneth. And ioynyng these three numbers, yf they come not to. 30, so many dayes olde is the Moone. And yf they be. 30. it is the coniunction. And yf they passe. 30. they also that passe, are the age of the Moone. To know the dayes or age of the Moone.

This is vnderstoode in the monethes that haue. 31. dayes, for in them that haue onely. 30. dayes, the coniunction is at the 29. day, and they that passe of. 29. are the age of the Moone. As for example. The fyrst day of August, of the concurrent. 17. of monethes from March. 6. and of dayes of the moneth. 1. make 24. and so much is the age of the Moone.

An other example. The tenth of September, of concurrent 17. of monethes seuen, of dayes ten, which are in all. 34. And because that September hath onely. 34. dayes, we must take away. 29. of the. 34. and so rest fyue dayes, whiche are the age of the Moone. And in lyke maner shall we geue to Februarie. 29. dayes of the Moone.

It foloweth, that the dayes of the Moone beyng knowen, then vnreckonyng or vnreckonyng backewarde, we To knowe the day of the coniunction.

we fynde for example. The.20.of July, the Moone hath. 12. dayes taken from the.20.remayneth.8. Then the eight day was the coniunction.

The day of the coniunction is lykewyse knowen by ioynyng the monethes (beginnyng in Marche) with the concurrent, and yf they come not to.30.then at so many dayes of that moneth as lacketh of.30.shalbe the coniunction.

Example.

In August.6.of the monethes, and.17.of the concurrent,are 23.which of.30.lacketh.7.Then at the seuenth day was the coniunction,and if they passe.30. then taking them that passe from the number of the dayes which the moneth had next before, and then that which remaineth,doth shew the day of the coniunction. Lyke as the Moone of September of the yeere. 1546. we shall count the concurrent.28.of monethes. 7. which are. 35. Then taking away the.5.from.30.and one which August hath,remayneth.26.and so the.26.of August,of the yeere to come of.1546. the Moone shal make coniunction.

The. vii. Chapter,of the declaration and vse of an Instrument, by the which is founde the place and declination of the Sunne,with the dayes and place of the Moone.

To know the place of the Moone in the Zodiacke,and what aspectes she hath with the Sunne.

IN the seconde and thyrde Chapter, I haue geuen rules to know the true place of the Sunne, and his declination. In this Chapter I wyll describe an instrument, whereby may be knowen the declination and place of the Sunne, and knowyng by the chapter past,the dayes of the Moone, shall also be knowen her place in the Zodiacke,and howe muche of her is lyghtened,and what aspecte she hath with the Sunne.

This

This Instrument is in square fourme, and hath by the sydes 23. degrees and a halfe, of the whiche the. 23. and a halfe that descende from the myddest downewarde, is the declination of the South signes: and the other from the myddest vpwarde, are the declinations of the Nozth signes. Within this quadzature is described a circle, by the circumference whereof, are the twelue signes and their degrees, ioyned to the circumference: and further within, is the number of them, and then theyr names. Yet further within this, is another circle, where are the twelue moneths, with their numbers and dayes. The description of the Instrument.

Then to the center of this circle, are annexed two rundelles, whereof the greatest & lowest is called the rundel of the Sunne.

This hath an Inder or shewer, in which is paynted the Sun, and in the circumference of it are the dayes of the age of the Moone. In the other circle, in the circumference thereof, is a rounde hole, representing the Moone: directly from the which, is another Inder comming forth of the circumference of this rundell, in which rundell are all the aspectes whiche the Moone maketh with the Sunne.

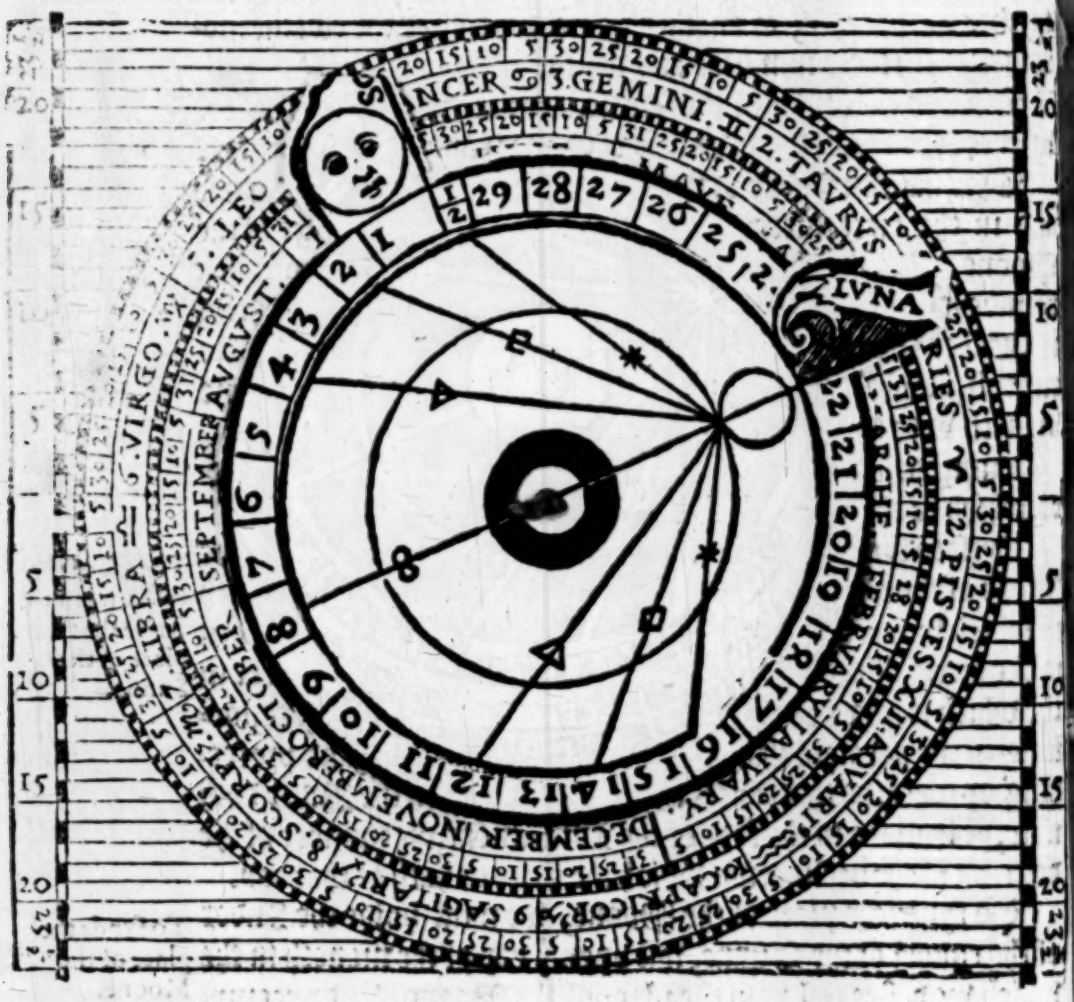
Hauing described the Instrument, let vs declare the vse thereof, which is this.

Fyrst to fynde the true place of the Sunne, we must put the Inder of the rundell of the Sunne, vppon the day of the moneth in which we are, or desire to know the place of the Sunne. Then in the circle of the signes, it shall shewe the signe and degree in the which it is: & in like maner, rolling styl vpon the degree, looking in the paralels that touch in the circumference, and proceeding by that line that toucheth the Sunne which the Inder doth note, ye shall see in the syde of the Instrument, the number of the degrees of the declination which the Sunne hath at that day. The vse of the Instrument to fynde the true place of the Sunne.

To fynde the place of the Moone, we must holde the Inder of the rundel of the Sunne, fast vpon ỹ day of the moneth in the which we desire to know the place of the Moone. And accompting in the rundel of the Sunne, the dayes that haue passed from the day of the Coniunction (as I haue sayde in the Chapter before) and where endeth that number of the dayes, yf there To fynde the place of the Moone.

we

we apply the index of the Moone, it shall shewe in the circle of the signes, the place where she is. And so shall she appeare in the instrument lightened, or darkened, more or lesse as in heauen. In lyke maner, consyderyng the place of the Sunne & the Moone, shalbe seene what aspect they haue, by the lynes that trauerse the superficiall of the Lunar circle of the Moone.



The

The aſpectes which the Planets haue one to another, or whereby they beholde one another, are fyue. Fiue aſpectes of the planets.

Coniunction is, when two Planets be vnder one ſelfe ſame degree and minute in the Zodiacke, whoſe charact is this. ☌ Coniunction.

Oppoſition is, when betweene the place of the Planettes is halfe a circle, which are. 180. degrees, and is thus figured, ☍ Oppoſition.

Trinall aſpect is, when betweene the Planettes ſhalbe foure ſignes, which are. 120. degrees, and is figured thus. △ Trinall.

Quadrine aſpect is, when one Planet is diſtaunt from another by three ſignes, which are. 90. degrees, whoſe charact is this. □ Quadrine.

Sextile aſpect is, when two ſignes are betweene them which are threeſcore degrees, and is marked thus. * Sextile.

And yf by memorie you deſyre to knowe the true ſpace of the Sunne, without reſpect of minutes (whiche may ſufficiently be done with the Aſtrolabie) beare in memorie theſe numbers 10. 9. 10. 11. 12. 13. 14. 13. 14. 13. 12. Of the which the firſt ſerueth for Januarie, the ſeconde for Februarie, with theyr ſignes: and ſo of the reſt. Then to knowe in what degree the Sunne is, you ſhall take away the dayes that are applyed to euery Moneth, accordyng to the ſayd numbers of the dayes for the which you deſyre to knowe the true place of the Sunne, and in them that remayne, in ſo many degrees is the Sunne of the ſigne into the which it entreth that Moneth. And yf the dayes paſt of the Moneth, ſhalbe leſſe then the dayes applyed to the ſame Moneth: you ſhall ioyne thirtie with thoſe dayes paſt of the Moneth, and of the ſumme that amounteth, you ſhall take away the dayes applyed to the ſayd Moneth, and the reſt ſhalbe the degrees in which the Sunne ſhalbe of the ſigne of the Moneth paſt, as for example. To know the Place of the Sunne by the rule of memorie. To know in what degree the Sunne is.

Example.

Januarie.	10	♒
Febyuarie.	9	♓
Marche.	10	♈
Apryll.	10	♉
May.	11	♊
June.	12	♋
July.	13	♌
August.	14	♍
September.	13	♎
October.	14	♏
Nouember.	14	♐
December.	13	♑

The. 22. of October, takyng away foureteene that were applyed, remaine eyght degrees of Scorpio, where the Sunne is.

Another Example.

The fyxe of December, whiche are lesser then twelue whiche is applyed vnto it, yf we ioyne fyxe to thyrtie, whiche are the dayes of the moneth next afore, they make 36. and from them we take away the. 12. reſt. 24. So in. 24. degrees, is the Sunne, of the ſigne of the moneth before, whiche is Sagittarie.

The. viii. Chapter, of the Eclipſe of the Moone and the Sunne.

THe Eclipſes of the Sunne and of the Moone, is a thyng that cauſeth great feare and admiration among the common and ignorant people, and to them that vnderſtande the cauſe thereof, nothyng at all. And therefore haue I thought good to declare the effectes thereof.

The Eclipſe of the Moone.

The Eclipſe of the Moone, is the interpoſition or beyng of the Earth betweene her & the Sunne. And whereas the Moone hath no proper lyght of her owne, and the earth, being darke and not tranſparent, maketh his ſhadow on the part oppoſite to the Sunne: the Moone by her proper motion doth paſſe by this ſhadowe, and is Eclipſed or darkened eyther in the whole or in part, accordyng to the portion of her that paſſeth by the ſhadow. Moreouer (as we haue ſayde) that onely the Sunne is mooued in the lyne Eclipticke, and the Earth being in the center of the worlde, the poynt or pricke of the ſhadowe ſhalbe vnder the Eclipticke. The Moone declineth from the Eclipticke ſometimes to the one part, and ſometymes to the other, becauſe her Eccentricke wherin ſhe is mooued, doth cut the Eclipticke equally into two halfes, ſo that the one halfe of the Eccentricke, doth decline from the Eclipticke towarde the North part, and the other halfe

The Mooung of the Sunne in the Eclipſe.

halfe towarde the South, and the greateſt declination of it from the Ecliptike, is. 5. degrees. In that maner, the Moone ſhalbe at no tyme in the Eclipticke, but only when ſhe ſhalbe in eyther of the interſections where the Eccentricke doth cut the ſaid Eclipticke. That interſection where ſhe paſſeth & goeth toward the North part, is called the head of the Dragon, and is marked thus. ☊ The other where ſhe paſſeth and decli-neth towarde the South part, is called the tayle of the Dragon, and is marked thus. ☋ And the Sunne mouing by his proper motion, and comming to the head, then ſhall the ſhadowe of the earth be in the tayle, becauſe it is the poynt oppoſite. And yf then the Moone come thyther, of her pro-per motion ſhe paſſeth by the ſha-dowe, and lackyng lyght of the Sunne, ſhe is eclipſed. And yf the Sunne come to the tayle, the ſha-dowe is in the head, and then like-wiſe ſhal the Moone be eclipſed, if ſhe paſſe by the head.



The head of the Dragon.

The tayle of the Dragon.

It is to vnderſtand, that ỹ ſunne is much bigger then the earth, and by perſpectiue, the ſhadowe of the earth in howe muche the farther it parteth from it, becommeth ſhar-per and ſharper, vntyl it come to a poynt: ſo that the ſhadowe of the whole earth, is pirramidally ſharp. And as the moone is leſſe then the earth, yet (although his ſhadowe goeth ſharpning) it ſuffiſeth to e-clipſe the Moone, if ſhe paſſe by the myddeſt thereof.

The Sunne is bigger then the earth.

The ſhadowe of the earth.

The Eclipse of the Sunne.

The Eclipse of the Sunne, is the interposition of the Moone betweene vs and the Sunne, as yf the Sunne be in the fourth heauen, and the Moone in the fyrst, she beyng a darke body, and by her proper motion ouertake the Sunne, then putting her selfe betweene him and vs, she couereth him in part, or in the whole, and this is the Eclipse of the Sunne. As the Sunne also goeth euer vnder the Ecliptykes, at that tyme that he commeth to the head or tayle of the Dragon, yf then the Moone make coniunction with hym, shalbe the Eclipse of the Sunne, for as muche as they are both vnder the Ecliptyke.

The Eclipse of the Sunne is not vniuersall.

The Eclipse of the Sunne can not be vniuersall in the whole earth, I say, vnto al them that may see the Sunne at the time of the Eclipse, as is the Eclipse of the Moone vniuersall. For yf the Moone haue one part Eclipsed, al that may see her, shal see her Eclipsed: But the Sunne some may see al wholly Eclipsed, and other in part, or other also not at all Eclipsed: and this al at one selfe same tyme. The cause whereof, is the diuersitie of the aspecte, whiche is, to see the Moone in the zodiacke out of her place: as yf the Sunne and Moone shoulde make coniunction in the begynning of Aries, and in the head of the Dragon, they that then should be in the Equinoctial, vnder the Sunne and the Moone, or that the Sunne and the Moone shoulde be in theyr zenith, they should see the Moone hyde al the Sunne.

Howe the sunne is eclipsed in the whole, or in part.

And they that shoulde be in the North Climates, shoulde see, that the Moone hydeth or darkeneth onely the South part of the Sunne, and not al. Againe, they on the South part, should see the Moone hyde the North part of the Sunne, and not all. And yf at the tyme of the coniuntion, she haue a lytle passed the head of the Dragon, or lacke a lytle to come to the tayle, so that she be in the North latitude: they that then shoulde be in the North Climates, shoulde see the Moone Eclipse all the Sunne: and they of the Equinoctiall shoulde see onely the North part of the Sunne Eclipsed, and they of the South shoulde see hym nothyng at all Eclipsed. So that although

although the Eclipſe of the Sunne ſhalbe totall or perticuler, it can not be vniuerſal in the whole earth.

Of the quantitie of the Eclipſes

And note, that for the quantitie of theſe Eclipſes, the Aſtronomers deuide into twelue equal partes, aſwel the Diameter of the Sunne, as of the Moone, and theſe partes they call figures, punctes, or prickes, and accordyng to the punctes of the Diameter of the Moone, whiche is couered by the ſhadowe of the earth, or the partes of the Diameter of the Sunne, whiche the Moone doth couer, ſo many fingers or punctes ſhalbe ſayd to be Eclipſed. As pf. 6. the halfe, pf. 3. a quarter, pf. 4. a terce, or thyrde parte, pf. 6. three quarters, pf 8. two terces.



Why the Moone ſeemeth ſomtime bygger, and ſometime leſſe, then the Sunne.

It is alſo to be noted, that although the Sunne be bygger then ỹ Moone, yet at ſome tyme the Moone ſeemeth greater then the Sunne. And this ſhalbe, when the Sunne is in the Auge of the Eccentrike, & the Moone in the oppoſite of the Auge of the Epicicle.

And when it ſo appeareth, he may be al Eclipſed. Sometymes alſo the Moone ſeemeth leſſe. This is when the Sunne is in the oppoſite of the Auge of the Eccentricke, and the Moone in the Auge of the Epicicle. Then although we ſhoulde ſee the center of the Moone in the center of the Sunne, ſhe can not hide hym al wholye, becauſe the Sunne ſhal appeare greater.

The Sunne is Eclipſed in coniunction, & the Moone in oppoſition.

Of this that we haue ſayd, it foloweth that al the Eclipſes of the Sunne, muſt of neceſſitie be in the coniunction, and the Eclipſes of the Moone in the oppoſition: whereby is inferred, that the Eclipſe of the Sunne in

The Eclipse of the Sunne in the death of Christ.

the death of Christe our redeemer, was not naturall, but miraculous: forasmuche as then was. xv. dayes of the Moone, at whiche tyme the Moone is at the full, and farre distant from the Sunne, and coulde not Eclipse hym. In lyke maner is to be noted, that to see the Eclipses, they of the Sunne must be in the day, and they of the Moone in the nyght. And whether the conunction be in the nyght, or the oppolition in the day, the Astronomers make none accompt.

How to see the Eclipses.

The ix. Chapter, of tyme, and of the definitions thereof.

Almouing is in tyme.

FOrasmuch as hytherto we haue entreated of the mouings of the Sunne and of the Moone, and howe all mouing is in tyme (for that nothyng may be moued in any instant or out of tyme) it shalbe conuenient nowe to declare what thyng Tyme is, and into what partes it is deuided.

What is time.

Time (as sayth the Philosopher) is a measure of mouyng, accordyng to fyrst and last, or before and after. Although by accident (as Armandus hath subtilly defined) Tyme may be a measure of rest or quietnesse: as measures of habites, are measures of myxtions. Or Tyme may be a measure of the mouyng of the fyrst moueable, called Primum mobile, and cause of generation thereby, and of corruption by accident. Tyme hath the limittes that hath the worlde, and as the worlde, so is it the cause of the mouyng of the heauens, and beganne when GOD created the heauens, and shall ende when the worlde shall haue an ende, as the holy Scholes of the Diuines teache vs. It is assigned to be within the heauens, forasmuche as without them, is neyther tyme nor any naturall place. All the tyme sence GOD created the worlde, vntyll it shall haue an ende, is called Seculum. (that is) a worlde, or an age of Tyme. Albeit, this worde

Howe time is cause of generation & corruption.

The beginning and ending of tyme.

The space of tyme.

Seculum

Seculum in an other sense, may be extended farther then the durabilitie or continuaunce of the worlde, and this in holy Scripture is called Seculum seculi, that is, The worlde of the worlde: or Secula seculorum, whiche is as muche to meane, as, The worlde and worldes to come, which signifieth, eternitie, or everlastyng worlde without ende. Lykewyse also, Seculum is taken for the space of a hundred yeeres, whereby in olde time certayne playes were called Seculares, because they were celebrate from a hundred, to a hundred yeeres. The Pope Paule, the thyrde of that name, commaunded them to be celebrate in Rome, in the yeere of. 1536. which was the yeere in the which the Seculum ended, and began a new Seculum.

And as in tyme are dyuers mooуinges, so hath it diuers measures, whereof some are greater, and other lesse. The greatest measure of tyme, is a reuolution of the heauens, which is slowly mooued, and the principall or chiefe of these, is that that the Sunne maketh, which we call a yeere. The lesse measure, is the mooуyng of the fyrst mooueable, which mooueth most swiftly: and this measure we call a day. And for as much as there is variation in the greatest measures, we wyll in the Chapter following, intreate of the yeere, and of the diuersitie thereof. Diuers mooуinges and measures of tyme.

The. x. Chapter, of the yeere, and of the diuers beginnynges and reckonynges, or computation had therof in olde tyme.

THERE are three differences of the yeere, as the great yeere, called Annus magnus, the solar yeere, and the Lunar yeere. The great yeere, is the space of tyme in the which all the Planettes returne to the place where they had been sometyme before. As yf they all had been in the beginnyng of Aries, and had begunne their course from thence, and shulde agayne all returne thyther: then should be the great yeere. Three differences of yeeres. The great yeere.

The reuolution of the eight Sphere.

By the deſcription of other, the great yeere is when the eight ſphere ioyntly with all the Auges, make one perfect reuolution at the mooueyng of the vyenth Sphere. And this ſhalbe in the ſpace of. xlix. thouſande yeeres.

The Solar yeere.

The ſolar yeere, is a reuolution of the Sunne, carried by the proper mooueyng of his heauen vppon the Axis and Poles of the Zodiacke, endyng where it beganne, and returnyng an other yeere by the ſelfe ſame courſe, as the Poet Virgil affyrmeth, ſaying.

Atq; in ſe ſua per veſtigia voluitur annus.

That is to ſay, The yeere turneth agayne to hym ſelfe by his owne proper ſteppes.

How the Egyptians paynted the yeere.

The Egyptians lackyng the vſe of Letters, and hauyng the ſame conſideration, paynted the yeere lyke vnto an Adder, byteyng her owne tayle: and hereof was a ryng called Annulus, as it were Annus (that is, a yeere) becauſe a ryng turneth round in it ſelfe, as doth the yeere.

The quantitie of the yeere.

Of the quantitie of this yeere were diuers opinions and computations among them of auncient tyme. The Arabians and Perſians accompted it regularly by xii. Moones, which are. 354. dayes. Romulus gaue to his yeere x. monethes, becauſe that tyme ſuffiſeth to a woman to byng forth her byrth, and alſo for that duryng ſo much tyme, it was not lawfull for a Wyddowe to marrie after the death of her huſbande.

The yeere of the Hebrues.

Numa Pompilius added two monethes, to make it vp twelue monethes in. 350. dayes, which was the moſt auncient yeere of the Hebrues, accordyng to the which, they accompt at this day.

The Grekes.

The Grekes and Egyptians, conſyderyng the courſe of the Sunne, made the yeere of. 365. dayes.

Iulius Cæſar.

Then by the commaundement of Julius Caeſar (whoſe order we nowe obſerue) were added fyre houres, to the ende to make equall this number of dayes with the courſe of the Sunne: and hereof the Biſextile or Leape yeere had his beginnyng, from foure to foure yeeres. But to ſay the trueth, they erred: The one, by ſomewhat too much, and the other by ſomewhat too litle.

Leape yeere.

Dayes of the yeere.

This yeere conteyneth. 365. dayes. 5. houres, x. 49. minutes.

Lyke

Lykewyſe at the fyrſt, the yeere had diuers begynnynges. Numa Pompilius beganne it from the Winter ſolſticiall, because that then the Sunne beginneth to ryſe toward vs, as Ouid affirmeth in theſe verſes. Beginning of the yeere. Ouid.

Bruma noui prima eſt, veteriſq; nouiſſima Solis.
Principium capiunt Phœbus & Annus idem.

Bruma is the ſtay of the ſunne in winter, the winter ſolſtitial, and ſhorteſt day of the yeere.

VVhiche may thus be englyſhed.

Brume is the fyrſt of the newe yeere,
And laſt day of the olde:
The Sunne and yeere beginne at once,
As Ouid hath vs tolde.

Romulus began it at Marche, at the Equinox of the ſpring, because that then all thynges reuiue and flouryſhe: and by the opinion of the Diuines, it ſeemeth good reaſon to begyn the yeere at Marche, because the worlde was created the. 25. of the Kalendes of Apryl, whiche is the. 18. of the moneth aforeſayde. Lykewyſe, God ſpeaking of this moneth to the people of Iſrael, ſayd vnto them, This ſhalbe the fyrſt of the monethes of the yeere. The Arabians begin from the Sommer ſolſtitial, whoſe opinion is, that the Sunne was made in the ſigne of Leo. Other begin the yere in September, about the Equinoctial of Autumne, as do the Iewes, reſtyng in the authoritie of Geneſis, where it is wrytten thus: Let the earth bryng forth greene herbes, to haue fruite agreeable to theyr kynde. &c. And because Autumne is a fruitefull tyme, they beganne from thence to accompt their yeere. The Grekes, Perſians, and Egyptians, accompt it from October. The Chriſtians, ſome from the Incarnation of Chriſte, other from his byrth, and other from the fyrſt day of Januarie.

The Creation of the worlde. Exod. xii.

Where the Chriſtians begin the yeere.

In lyke manner, is great diuerſitie in begynnyng the number of yeeres, whiche we call Era, that is, the date. The Grekes beganne their date, from the death of great Alexander. The Egyptians, from the death of Nabuchodonoſor. The Perſians,

Diuerſitie in the number of the yeeres or the date.

sians from Gesdargit. The Arabians or Moores, from the
Machomet. preaching of Machomet, who was after the byrth of Christ. 626
yeeres. Other also from the Romane Emperours. The Christi-
The date of the Christians. ans began the accompt of our Sautour Jesu Christ 500. yeres
after his byrth, as writeth Cardinal Cusanus. And here it shall
not be from my purpose, to shewe howe iustly and ryghtfully
was commaunded by Don John kyng of Spayne, the fyrst
of that name, that in the Courtes and Parliamentes whiche he
helde in Segouia, in the yeere of. 1383. leauyng the dates that
they had begun from the Emperour Octauian, for tributes and
other paymentes specified in Wrytynges and Priuiledges,
they should no more put the date of the Emperour, for as muche
as the day in the which the Sonne of God became man, & was
borne by the blessed Virgin, was for excellency & thyng, and most
woorthie to be had in memorie. So that in Spayne, since that
tyme, in all common Wrytynges, the date is made from the
Natiuitie of our Lorde, begynnyng there the fyrst day of the
yeere, and commonly the fyrst day of January. Some Astrono-
mers begyn it the fyrst of Marche.

We haue in this Chapter entreated of the great yeere, and
of the Solar yeere, with his quantitie, begynnyng, and date. In
the Chapter folowyng, we wyll entreate of the Lunar yeere,
whiche we call a moneth.

The .xi. Chapter, of the moneth, and of his differences.

The Lunar yeere, or moneth. Reuolution of the Moone.

ONly vnderstandyng the moneth absolutely, with-
out hauyng respecte to the Solar yeere, it
may be called a yeere, accordyng to
the deuision we haue made in the Chapter
of the yeere. For it is a reuolution of the
heauen of the moone which moueth slowly
in comparison of the fyrst heauen. And yf
we

we consyder the moneth as part of the yeere, then is the name of a moneth more proper vnto it. For this word Mens mensis, in Latin, is deriued of Mensura, whiche signifieth measure. And so the moneth and yeere referred to tyme, all may be called moneth: forasmuch as all is the measure of tyme, as we haue touched in the sayd Chapter of the yeere.

The moneth is to be consydered in two maners: eyther (as it is) part of the Solar yeere, or is caused by the course of the Moone. The moneth that is parte of the Solar yeere, is that whiche at this day we vse. And into xii. of these monethes, is the yeere deuided: as Januarie, Februarie, Marche, Aprill, May, June, July, August, September, October, Nouember, December. The deuision of the yeere into twelue monethes.

They are not all of equall dayes, Aprill, June, September, and Nouember, haue .30. dayes: all the other haue .31. except Februarie, whiche hath .28. and when the Bisextile or Leape is, it hath .29. The names and numbers of these monethes were assigned at the wyl and pleasure of men, and the cause why they haue remayned so long time, is the authoritie of the Emperours, that ordeined them for the common people, who accepted them by the Romane Church, whiche admitted the vse of them.

The Lunar moneth hath two consyderations. The one is the tyme whiche the Moone tarieth from that she commeth forth from one point of the Zodiacke, vntyll she returne thyther by her proper mouyng, and this is called the moneth of the peragration: in whiche reuolution she spendeth .27. dayes, and almost .8. houres. The other consideration is, hauyng respect to the tyme whiche the Moone tarieth, from that she is in coniuntion with the Sunne, vntyll another coniunction. And this is called the moneth of Conseruation, and is more then the moneth of Peragration, by two dayes .4. houres .44. minutes. For the Sunne and the Moone beyng in coniunction vnder one punt of the Zodiacke, and mouyng both by theyr proper mouoynges, towarde the East, as the mouyng of the Moone is swyfter then the mouoyng of the Sunne, she leaueth hymbehynde. The Lunar moneth. The moneth of peragration. The moneth of consecution. The mouyng of the Sunne and Moone in coniunction.

And

And when she hath ended her moneth of peragration, she returneth to the poynt from whence she departed, and not findyng the Sunne there (because in the meane tyme the Sunne of his propermotion hath gone almost .27. degrees) the Moone passeth from this poynt, and in the sayde .2. dayes .4. houres 44. minutes, ouertaketh the Sunne: and so commonly hath this moneth of consecution. 26. dayes .12. houres, and .44. minutes. So that whatsoeuer is sayd of the Lunar moneth, is to be vnderstood of this moneth of consecution, whiche all they vse that accompt by Moones: as doo the Hebrues, Arabians, and Persians.

To knowe the tydes by the aspectes of the Moone.

The Mariners ought not to neclect this computation, because it is conuenient for them to knowe the tydes, and other effectes caused by the aspectes of the Sunne and the Moone, for their aspectes do correspond to the partes of this moneth, as the coniunction to the beginning, the oppositiõ to the middest, and the quartile aspecte to the quarter, and so of the other. Lykewyse in this moneth, is considered the illumination of the Moone, and the dayes that the lyght fayleth her: so that neyther by day nor by nyght we may see her, for beyng burnt vnder the beames of the Sunne. The tyme that she is so, is called Interlunium (that is) the chaunge or hydyng, whiche is sometyme more, and sometyme lesse. When the coniunction shalbe from the begynnyng of Capricorne vntyll the ende of Gemini, and the Moone hath North latitude, and her mouyng swyfte: then shall the newe Moone soone be seene, and so shall the Interlunium be but lytle. And when the coniunction shalbe from the begynnyng of Cancer, vntyl the ende of Sagittarius, and the Moone hath South latitude, and her mouyng slowe, the longer wyl it be or the newe Moone shewe her selfe to vs: and certayne of the causes concurryng, and not all, so shall the Interlunium be in a meane betweene both.

The illumination or change of the Moone

Interlunium, is the space of tyme in the which neither the old Moone doth appeare, nor the newe moone is seene.

(*.*)

The

The xii. Chapter. Of the weeke.

THE weeke is a tyme of seuen dayes, the begynnyng whereof is Sunday, and so did the Iewes count their first day, saying, Prima Sabati, secunda Sabati. (that is) the first of the Sabboth, the seconde of the Sabboth. &c. to the sixth of the Sabboth, and then the Sabboth. The Romanes that called the planets Gods, forasmuch as the Sunne was principal among them, called their fyrst day, the day of the Sunne, the seconde, of the Moone, the thyrde, of Mars, the fourth, of Mercury, the fyfth, of Iupiter, the syxth, of Uenus, the seuenth, of Saturne. The Christians solemnising the Sunday, began their accompt from it: as, on such a day our Lorde was borne: on suche a day he rose: and on suche a day he sent the holy ghost vpon his Apostles. &c. They also accompt the dayes of the weeke for Ferias.

The weeke of the Iewes.

The Romans.

The Christians.

Ferine, signifieth vacant dayes, or some tyme holy or festiual dayes.

The xiii. Chapter, of the day, and of the nyght.

THE day is of two sortes, as, the naturall day, and the artificiall day. The naturall day, is the space of tyme, wherein the Sunne is caryed by the fyrst moueable about the earth, from the Meridian, to the Weast, and from the Weast vnder the earth, commyng to the East, and from thence returnyng agayne to the sayde Meridian: and this time hath the Equinoctiall geuen one whole turne, and more, suche part of it as correspondeth to the proper mouyng of the Sunne: or otherwise, the natural day is a circle discribed with the center of the Sunne, at the mouing of the first mouable. The Romanes began this natural day, from midnight, and ended it in the mydnyght folowyng, and so doo we accompt it for fastyng dayes: and

The naturall day.

The beginning of the natural day

and from euenyng to euenyng, in celebratyng of feſtiuall dayes. The Athenienſes began it at the Sunne ſet, or goyng downe of the Sunne. The Babylonians, at the riſyng of the Sunne. The Umbrians, and Etheſeos, from the mydday, or noone, and ended it the noone day folowyng. In this manner doo the Aſtronomers begyn it, and fynde that the day ſhall euer begyn at one ſelfe ſame houre for the qualitie of the Meridians. And yf they had begunne it from the riſing or fall of the Sunne, it ſhould not be euer at one ſelfe ſame houre, becauſe the Sunne riſeth and falleth at ſometymes ſooner, & at other tymes later: and ſo ſhould the begynning of the day be variable. And it is to vnderſtande, that when we commonly ſay, at the tenth day of ſuch a moneth: the ſame tenth day dooeth ende the ſame day at noone, and the houres that runne from that nooncetyde forewarde, are of the eleuenth day: and ſo doo the Aſtronomers accompt them.

The ende of the naturall day.

The artificiall day.

The nyght.

The day artificiall, is part of the day natural, and is the time that the Sunne tarieth from that it riſeth in the Eaſt, vntyll it fall in the Weaſt. And the nyght is that part that lacketh or fayleth for the naturall day, which is the time that the Sunne taryeth from that he hideth hym ſelfe in the Weaſt, vntyl he returne to appeare in the Eaſt: and ſo the day artificiall and the nyght, make one naturall day. And accordyng hercunto, it is written in Geneſis, that of euening and morning was made one day. Iſodorus defining this artificiall day, ſayth, that the day is the preſence of the Sunne, or the beyng of the Sunne aboue the earth: as it is nyght vnto vs when he is vnder it. Or otherwiſe, the nyght is the ſhadowe of the earth, extended diametrally oppoſite to the Sunne. The quantitie and differences of theſe dayes artificiall, and theyr nyghtes, and howe they increaſe and diminyſhe, whe haue largely declared in the fyrſt Chapter.

The

The xiiii. Chapter of houres.

AS there is two differences of the day, as the naturall day, and artificiall: so is there two differences of houres, as houres naturall, whiche coꝛreſponde to the naturall day, and houres artificiall, whiche coꝛreſpond to the artificiall day. Hora oꝛ Ora is a Greeke name, and ſignifieth ende. And ſo ſay we Ora maris, foꝛ the ende oꝛ bymme of the ſea, oꝛ the liſt oꝛ edge of apparell, as ſayth Iſodore in his Etimologies. The houre natural oꝛ equal, is a.24. part of the day natural, & is the tyme of paſſyng fyfteene degrees of the Equinoctial. Theſe 24. houres that make one naturall day, the Aſtronomers dooth begyn the day at the Meridian, compting the houres after the oꝛder of the fyxt mooueable, which is from the ſayd Meridian, in the angle of mydnyght, where they accompt twelue houres, and from thence toward the Eaſt, and come to ende the .24. houres in the ſame Meridian where they began: and this they vſe foꝛ the computation of the tables of the mouinges of the heauens. The Aſtronomers vſe the ſame in their inſtrumentes, as in the Aſtrolabie, and Dials Hoꝛizontal, and vertical, and in all other inſtrumentes foꝛ houres. In Spayne alſo we vſe to accompt theſe .24. in two tymes twelue, begynnyng at noone, and endyng twelue at mydnyght: and agayne, begynnyng at mydnight, and endyng other twelue at noone. And to diſtinct the one from the other, they cal the one afternoone houres, and the other foꝛenoone houres: and commonly we ſay ſyxe houres of the moꝛning, & ſyxe of the euening. In Italie they accompt them from the fallyng of the Sunne, vntyl the next fall the day folowyng.

Houres natural and artificiall.

The houre natural or equal.

The houre artificial or temperal.

The artificial oꝛ temperal houre, is a twelfe part of the day arcke, oꝛ the nyght arcke.

They

They are called temporall houres, because they varie in the tymes that the day varieth: For in the tyme that the dayes shal be great, so shalbe the houres: and when the dayes shalbe short, so lykewise shal the houres be, and in lyke maner of the nightes. So that, as the artificiall day, great or lytle, is deuided into twelue houres: euen so the nyght great or lytle, is deuided into other twelue. The auncientes deuide the day into foure partes, and the nyght into other foure, geuyng vnto euery quarter part three houres. At the rysyng of the Sunne, which was the fyrst houre of the fyrst quarter, they called the fyrst houre: and three houres passed, they called the thyrd houre, and syxe houres passed of the day, they called the syxth houre, whiche was the myddaye or noone tyde. Also the nienth houre, they named at niene houres past of the day. And the Sunne set, or goyng downe of the Sunne, they called the Euenyng: as sayth the Poet Virgil in this verse.

The day and nyght deuided into foure partes.

Ante diem clausam componet vesper olimpo.

And according to this computation, is to be vnderstood that wryteth Saint Matthewe: That the labourers came to the Vineyarde at the eleuenth houre, whereby is meante the fyfth houre, one houre before the Sunne was set. And when we reade in S. Iohn: The ague left hym the seuenth houre. &c. By this accompt it was one houre after noone, when Christe healed the sonne of the Ruler that was diseased in Capernaum. In lyke maner by these houres, the auncientes deuided the nyght into foure quarters, geuyng three houres to euery quarter. And in these foure partes of the nyght were Souldiers appoynted to watche. In the fyrst quarter, whiche they call Canticinium (and we the fyrst sleepe) they watched all. In the second, whiche they called Intempestinum beyng the turne of midnyght, the young men watched. In the thyrd, which the called Gallicinio, of the crowyng of Cockes, watched the Souldiers of middle age. In the fourth and last quarter, called Matutinum or Antilucanum (that is, the spryng of the day) the olde Souldiers watched. And thus is vnderstood the fyrst, the seconde, and thyrde watche,

Interpretation of certayne places of the Gospel.

The night deuided into iiii. quarters.

Foure watches of the nyght.

watch of the nyght, in lyke maner ought the Mariners to keepe watche and warde, to auoyde aſwell the peryll of the ſea, as alſo the daungers of Roucrs: and to deuide the nyght by quarters, after the maner of Souldiers, as dyd alſo the Mariners in olde tyme.

How Mariners ought to watch

The. xv. Chapter, of the makyng and vſe of an vniuerſall Dyal for the day.

Whereas in the Chapter before, we haue intreated of houres, and theyr dyfferences, we entende here to deſcribe the makyng of an Inſtrument generall, to knowe the houres of the day by the beames of the Sunne, which is done in this maner. Take a rounde plate of Laton, and let it be called the Equinoctiall circle, the circumference whereof, you ſhall deuide into. 24. equall partes by both the ſydes, and from the center to euery of theſe partes, you ſhall drawe a ryght lyne: one of the which ſhalbe a Meridian. And in the one part of that, wryte twelue, whiche ſhalbe the houre of the mydday or Noone. And in the other part, wryte other twelue, which ſhalbe for Mydnyght. In the higheſt part, turnyng vpon the center, towarde the ryght hande, wryte, one, two, three, foure. &c. In the lower, or neather parte, you ſhall count towarde the left hande, turnyng it vppon the center: ſo that the one houre of the one parte, come vppon the lyne of the one houre of the other parte, in lyke maner two vppon two, three vppon three, and ſo forth of the other. And note that in the lyne of Syxe at after Noone, and at the lyne of Syxe in the Mornyng, there remayne certayne rounde peeces, coners, or endes, after the maner of Axis, of the thyckneſſe of the ſame plate. Then make a halfe circle of the ſame mettall, as bygge as the halfe circumference of the plate, and of the thyckneſſe of a peece of foure ryalles of Plate, or ſomewhat

To know the houres of the day by the Sunne.

more, euen as the plate it selfe, and of the breadth of halfe a fynger, if the instrument shalbe great: or lesse, if the instrument shalbe lesse. This halfe circle, shall you graduate or diuide into 180. degrees, beginnyng at the one ende, one, two, three, and so foorth, vnto. 90. in the myddest, and the lyke shall you doo from the other ende vnto the same. 90. Also, you must number them in the breadth of the same halfe circle: and this halfe circle, shall you make fast on the neather part of the instrument, so that the endes thereof may be fixed in the endes of the Meridian line. Then through the center of the plate or Equinoctiall circle, shal passe a rounde steele or wyre of the same mettall, made fast or soldered in it, so that it rise and come foorth equally from euery side of the plate the fourth part of the Diameter of the same, and this shalbe called the Axis or exiltree of the worlde. The instrument being thus made, you shall place it, or set it in a frame, hauing two armes, standardes, or arches, so that it change betweene the sayd arches, borne vp by the rounde peeces or endes of the plate, left therof at the endes of the line of the syxe houres aforesayd, in such sort, that being thus stayed, it may be directly turned. And in the myddest betweene these two armes, beneath in the foote of them, or where they are placed, you shal rayse a pricke, or poynt: so that the plate which signifieth the Equinoctial, being perpendiculer, the brymme or edge thereof may fall vpon the poynt or pricke, and consequently the plate standyng playne or flatte, the nientie degrees of the halfe circle, must shew or touche the sayde pricke, as shal also the end or extremitie of the Axis of the world, and the other ende shall shewe the Zenith or vertical poynt.

The plasing of the instrument.

This instrument must be so placed, that the Meridian line be North and South: whiche you shall finde in this maner. In an open and playne place, where the Sunne shyneth for the most part of the day, you shall make a circle with a payre of compasses, in the middes whereof, you shall set a steele or wyre, so vpryght, that it declyne not, or bende not, eyther one way or other, and the same no longer then the fourth part of the Diameter of the circle. Then in the mornyng when the Sunne ryseth, the

The fyndyng of the Meridian lyne.

shadowe

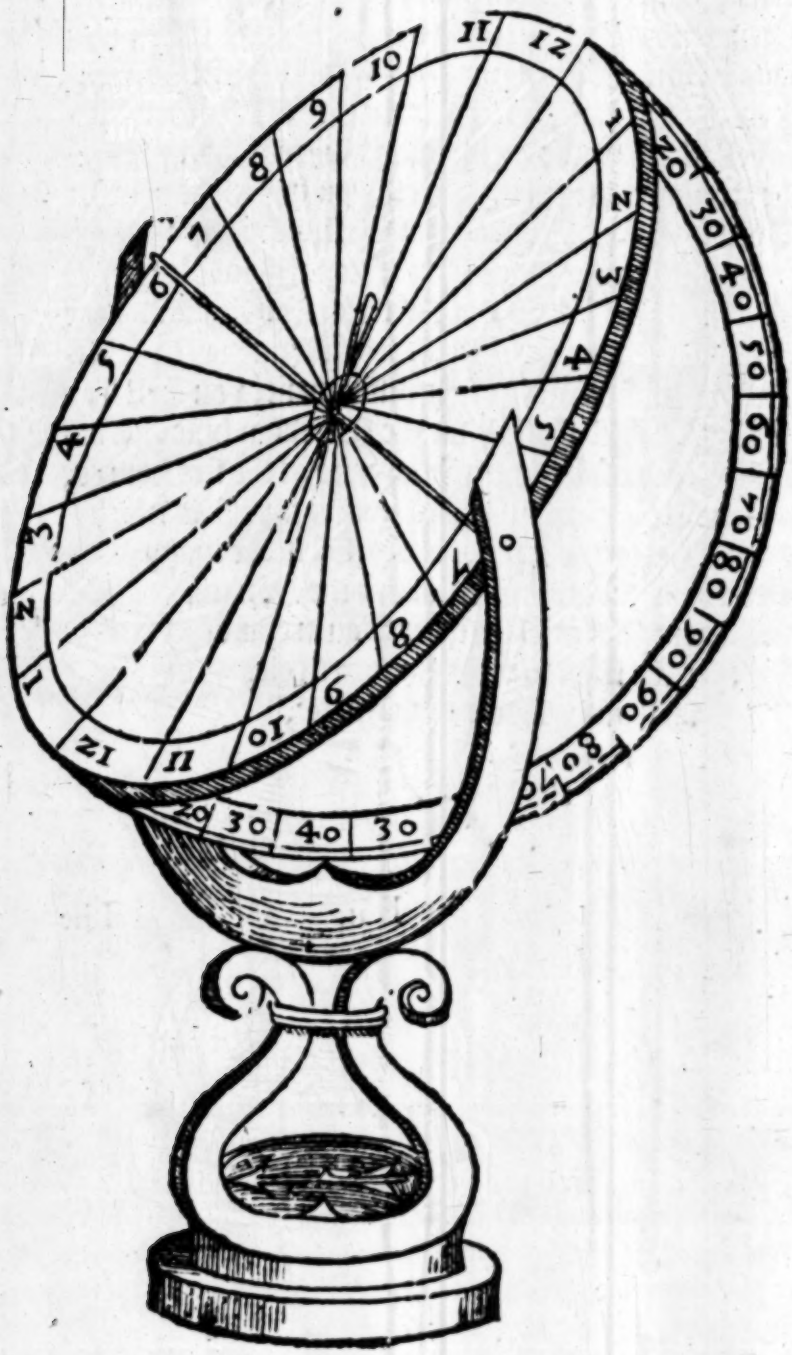
shadowe shalbe very long, and as it ryseth hygher and hygher, so the shadowe waxeth shorter and shorter. Then must you obserue the tyme, when the extremitie or ende of the shadowe toucheth in the circumference of the Circle, and where it toucheth you shall make a pricke. Then goeth the shadowe shortnyng vnto the myddaye or noone tyde, and as from thence the Sunne declyneth, so doeth the shadowe encrease, and when it shall come agayne to the circumference of the Circle, you shal make another pricke. Then shall you part in the myddest, the arke that is betweene the one pricke and the other, and from the middle pricke, draw a ryght lyne to the center of the Circle: And that shalbe the Meridian line, whereupon you shal set the instrument. Furthermore, in the foote of the frame of the instrument, you shall set a compasse or Dyal, which shall shewe the Meridian lyne. This done, vpon the arches of the frame, & corners of the sixe houres, you shall turne the Equinoctiall, so far, that it passe so much of the halfe circle by the myddle pricke, howe many degrees the Pole is raysed aboue the Horizon of that region or place where you are, and then the shadow of the wyre or steele, shall iustly shewe in the Plate, the houre, and what a clocke it is.

The elevation of the Pole.

* * *

The seconde part

Here foloweth the Figure of the Iustrument.



The .xv. Chapter, of certayne particuler Dials, Mural, and Horizontall.

AMong sundry maner and fashions of perticuler Dials, there are two principal. Whereof the one is Horizontal, whiche is placed in the superficiall of the Horizon: the other is verticiall, and must be made or set on a wall perpendiculer, and directly agaynst the South or Mydday, from the true leuant or East, to the true ponent or West, the whiche the Mariners call East and West. To make any of these two Dials, you must drawe a ryght lyne, and call it the Axis of the poles of the worlde, vpon the whiche you shall drawe an halfe circle, and deuide it in. 90. equall partes. And where the halfe circle is cut with the lyne of the Axis, must be accompted by the circumference, the altitude of the pole for the citie or place for the whiche you intende to make the Dyal. And in the poynt of the circumference where endeth the altitude of the pole, you shall make a marke, and write there, The altitude of the pole. And from that poynt draw a ryght lyne vnto the poynt where you began to accompt the altitude of the pole, whiche lyne shalbe called the Semidiameter, or halfe Diameter of the vertical circle. And from the same poynt of the altitude of the pole, drawe another ryght lyne to the other extremitie or ende of the Axis, and this shalbe called the Semidiameter of the Horizon: and likewyse from the same poynt of the altitude of the pole, draw a ryght lyne perpendiculer vntyl it touche in the Axis, and this shalbe called the Semidiameter of the Equinoctial. Hereby is considered a Triangle, whiche hath by the sydes thereof the Semidiameter of the vertical, the Semidiameter of the Horizon, and the Axis of the worlde, whiche Triangle shal serue afterwarde. These three Semidiameters, of the vertical, the Equinoctiall, and the Horizon, beyng founde, you shall make the Dyal in this maner.

Dials Horizontal and verticall.

East & West.

The triangle.

The making of the Dyall.

Drawe a ryght lyne somwhat long, and call it the lyne of contingence. This shall you cut with an other lyne in ryght angles, after the maner of a crosse, whiche shalbe the Meridian lyne. Then with your compasse, take from the Triangle the Semidiameter of the Equinoctiall, and of this bygnesse draw a circle vpon the Meridian lyne: so that the edge or bynnne of the circle, touche in the lyne of contingence. Then with a compasse, take the Diameter of the verticall circle, yf you wyl make a murall Dyal, or the Semidiameter of the Horizon, yf you wyll make a Horizontal Dyal, on a playne or flatte fourme. Therefore with suche Semidiameter as you desyre, you shall drawe a circle vpon the other part of the Meridian lyne, so that the circumference thereof touche in the lyne of contyngence. Then shall you deuide the Equinoctiall circle into foure equall partes, and the quarter that is towarde the lyne of contingence, shal you deuide into syxe equal partes. And settyng the ende of the ruler in the center of the Equinoctial, and vpon euery poynt of them that deuide the syxe equal partes, from thence shall you drawe certayne ryght lynes, vntyll they touche in the lyne of contingence. And from these poyntes of the line of contingence, you shal drawe other ryght lynes, to the center of the Horizontal circle, whiche lynes shalbe the determiners of the houres. And neare vnto the Meridian lyne, where it toucheth in the lyne of contingence, you shal wryte twelue, and consequently towarde the East, you shal wryte, one, two, three, foure, fyue, syxe: and from the syxth houre, you shal drawe a ryght lyne, which shall passe by the center of the Horizontal circle equally distaunt from the lyne of contyngence. The one quarter of the Horizontal beyng drawne by the selfe same, and of the same measure and bygnesse shal you drawe the other, in suche sort, that the same bygnesse that is from twelue to one, the selfe same shall you geue from the twelfth, to the eleuenth: and the same bygnesse and measure that is from one to two, shal you geue from eleuen to twelue, and so forth of the other.

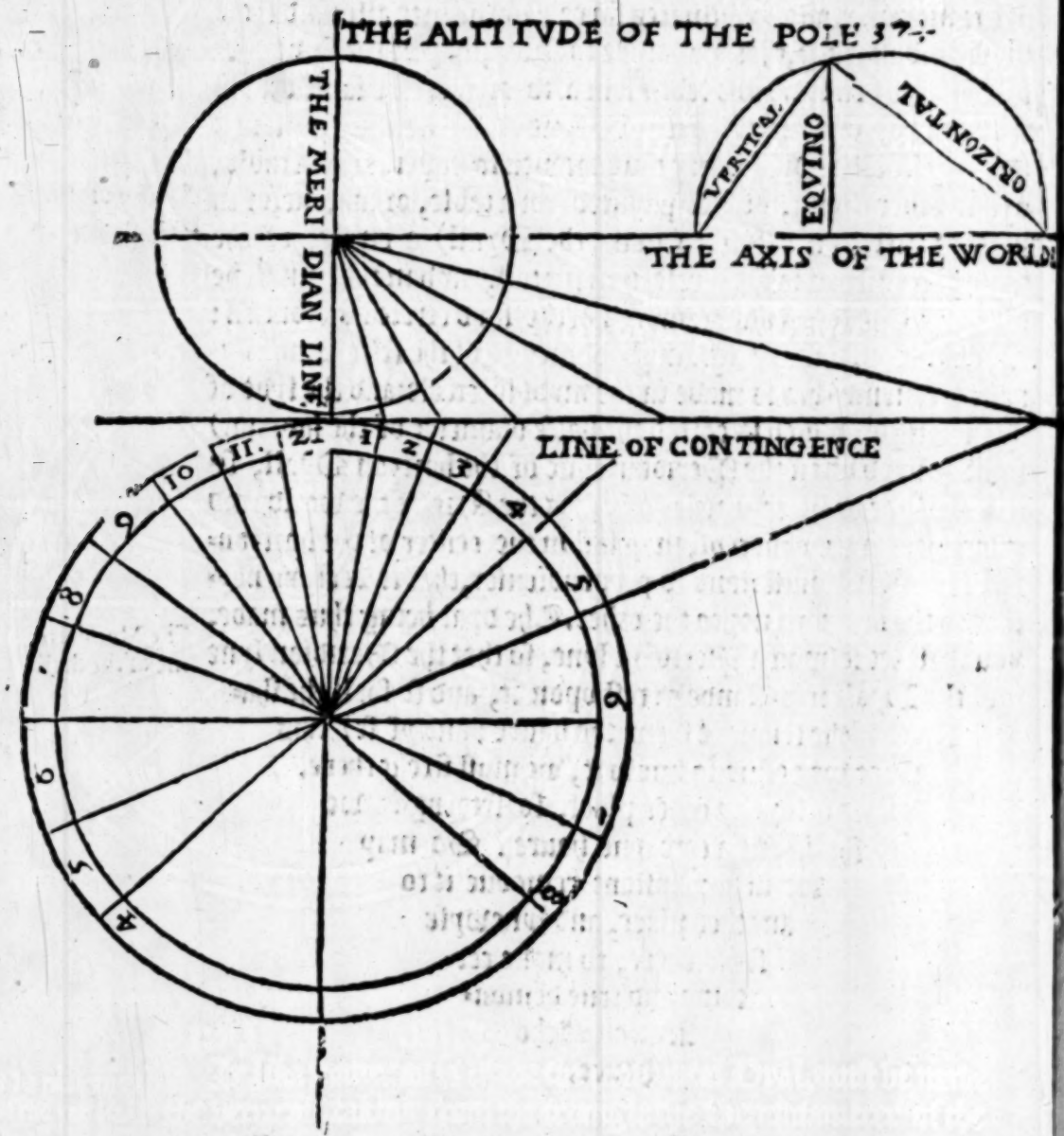
And note that the Horizontal Dyal, after the syxth houre of the euenyng, shall haue the houres of seuen and eyght, and

and in climates farre Nozth.ri. also, and moze yͤ nerde shall re- Houres of the horizontal Dyall.
quire, and consequently must haue the houres of fiue and foure of the mozning, and in climates farre Nozth, three also: and these must be so marked, that from syxe to seuen, may be the same that is from fyue to syxe, and from seuen to eyght, the same that is from foure to fyue: also, foure and fyue of the mozning, as seuen and eyght. The Dyal being thus drawen in paper, oz on a table, oz any other thyng, must be paynted (on a table, oz in stone, oz in what so euer you desyre to make the Dyall) a circle, of the same bygnesse as is the circle hozizontall, and in that must be translated the lynes and numbers of the sayd circle hozizontall: Then must you make a triangle of metall, of the selfe same bygnesse & fourme that is made in the mydde circle: and the syde of this triangle (which is called the halfe diameter of the hozizon) must be fixed vpon the Meridian lyne of the hozizon Dyall, so that the syde of the tryangle (which is the Axis of the wozld) and extremitie oz ende thereof, may fall in the center of the hozizontall Dyall, and must stand so perpendiculer, that it declyne neyther to the one part, noz to the other. The dyal being thus made, you shall set it vpon a Meridian lyne, so that the Meridian lyne of the Dyall may stande oz rest vpon it, and so shall the shadowe of the triangle shew the houre: and yf foz this place we desyre to know it, we must fixe it there. And if foz any other place, so settyng it, we shall haue a certayne houre. So may we in any instant remooue it to another place, and lykewyse set it there, to make certaine and true demonstration of the houre.

Placing of the Dyall.

The Meridian line of the dial.

Here followeth the Figure of this demonstration.



The makyng of the vertical Dyall.

In like maner as is made the horizontal Dyal, must be made the verticall, taking from the triangle the Semidiameter of the Circle verticall.

And note, that for the Circle verticall, it shall not be nede-

ful of more then sixe houres before noone, and other sixe after noone. And the triangle must be sixt in the meridian lyne vpon the side that is called the Semidiameter of the Circle vertical. And yf you wyl not make a triangle of metal, but that a wyre of Iron may gyue the shadowe, then must you make the sayd triangle of past or paper. And according to the forme or paterne thereof make the wyre of Iron, and cause the same to be sixt in al sortes of dials, as is before.

The.xvii. Chapter, of the composition and vse of an instrument general for the houres of the nyght.

Where as in the Chapters past, I haue described the manner and forme to make two dials for the houres of the day, me seemeth that for the more perfection of this woorke, it would be conuenient here to teach the makyng of a dyal to knowe the houres of the nyght, by the Circle whiche the two starres, called the Guardians, or the mouth of the horne, doo describe by the moouyng of the fyxte moueable. But for as muche as it is a common opinion, that in the myddest of Apryll it is mydnyght when the Guardes be in the head, wherof they take the begynnyng of the yeere, I wyll declare howe it ought to be vnderstoode. Certayne it is, that to be mydnyght, is none other thyng but the Sunne to be by the moouyng of the fyxt moueable, to euery one in that parte of his Merdyan that is to hym vnder the earth, euen as is to hym mydday, or noone, when to hym it is in that parte of the Merydian that is aboue the earth. And in this present yeere of .1545. (to be out of doubt hereof) I made experience with a precise Astrolabie, so that the fyxt or foremoste Guarde starre, beyng perpendicularly ouer or aboue the North starre, I founde in the meridian, where the sunne maketh mydnyght, the.ix. degree of Taurus, whereby it foloweth, that the sunne being in this degree, which is at the.xix of Apryl, the same Guarde starre shalbe perpendicularly ouer the

The Guarde starres.

What is mydnyght.

None or mydday.

the North starre, whiche is the lyne of the head, and consequently the sunne beyng in the nienth degree of Scorpio, which is at the xxii. of October, the guarde starre shalbe in the lyne of the feete: and by this calculation may be knowen when it shalbe in the ryght or in the leafte, and in all the other lynes: so that they manyfestly erre, that accompt the mydnyght at the .xv. of Apryll, when the first guard starre is in the lyne of the head, accomptyng a terce or thyrde parte of an houre sooner and more then they should doo.

An errour.

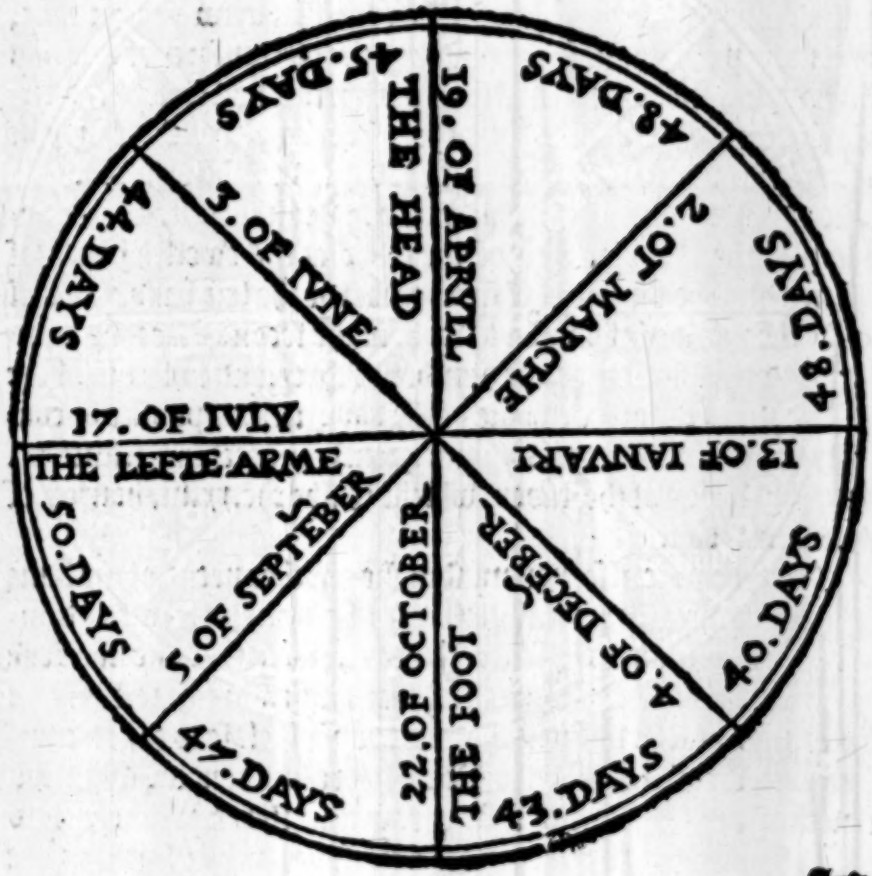
The making of the instrument.

Hauing thus geuen principles for the instrument, you shall proceede in the makyng thereof, as foloweth. In paste, or on a plate of laton, make a circle of the quantitie of a spanne, or of the bignesse that you desyre the instrument or dyal to be: then make an other circle somwhat lesse, so farre distaunt from the greater, that betweene the one and the other may be a space, in the which may be signed or marked the dayes and monethes. Likewyse shal you make another lesse circle, leauing space to set the numbers of the dayes of euery moneth. And vnder this circle, shall you make another, leauing space to wryte the names of the monethes: then shall you deuide the first and greatest circle into eyght equal partes, so that the .xix. of Apryl may be in the highest or vppermoste part of the instrument, whiche is where they say the lyne of the head to be, and the .xxii. of October must be in the neather part. Also, the .xiii. of Januarie, in the ryght arme: and in the leaft arme, the .xvii. of July: and so the other dayes that doo fall to the other lynes, accordyng as they answeare to the ryght assension of the sunne, as you may see in this figure.

This being thus diuided, you must also diuide the spaces that are betweene the one lyne and the other, into the dayes whiche be numbred in euery space: so that betweene the .xix. of Apryll, and the thyrde of June, are .45. dayes, and that space shal you deuide into .45. partes. And whereas the instrument beyng small, it can not in so lytle space receyue so many partes, you shal deuide it from fyue, to fyue partes, and so shal you deuide the other spaces by the numbers that are signed in them.

Then

Then one day moze before the .x. towarde the lefte hand you shal make a strike, and there shalbe the .xx. of Apryl. And fyue dayes moze before, make another stryke, and there shalbe the .xv. And yet other fyue dayes moze before, whiche shalbe the .xxx. of Apryl, make another strike ouerthwart vnto the neathermost circle, and there shall May begyn: And from these dayes shall you begyn to accompt the dayes of May from fyue to fyue. And in the last space you shal put syxe, whiche shal make the .xxxi. dayes that May hath.



And

And there shall you make another strike, whiche shal trauerse or ouerthwart vnto the lesse circle. And in this maner you shal deuide the other monethes, geuing to euery of them the number of his dayes.

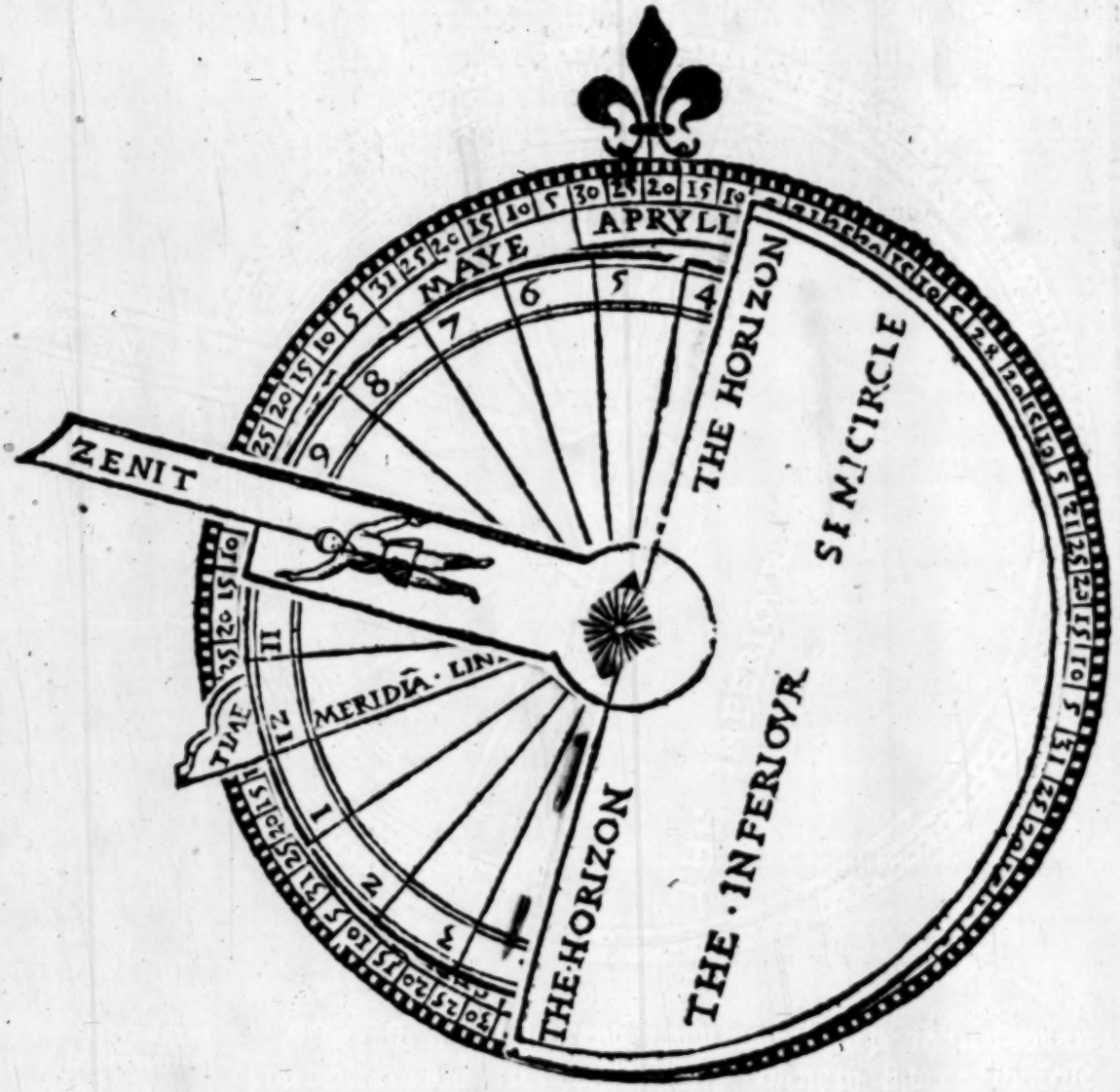
This beyng done, vpon the outward part of the great circle, you shal cut downe the paper, paste, or plate of laton, leauing of the same for a signe or marke a floure Delice vpon the .xix. of Aprpyl, for that it must be the head: and lykewyse at the .xxii. of October, may be left a handel to holde it by. Then must you make a rundel to the same past or laton, of the bignesse of the lesse circle, without the circumference whereof, shalbe left a tooth or inder, in the which you shall wryte, Tyme. And from the one syde of this inder towardes the left hand, you shal draw a ryght lyne, that may passe through the center to the circumference, & this shalbe the Meridian lyne. Also to this rundel you shal geue a circle, so muche lower from the circumference, that there may be left a space where the number of the dayes may be wrytten. And this rundel you shal deuide into .24 equal partes, begynnyng at the Meridian lyne of the inder at the twelfth houre of the nyght. Then in the next space towarde the left hand, you shal make the number of one. Lykewyse in the second space the number of two, in the thyrde, the number of three, and so fourth of the residue, vnto the other twelue of the day, in the opposite or contratry part of the inder. So consequently procedyng .i. ii. iii. &c. vnto the twelue of the inder, whiche shalbe the .xxiiii. houres of the natural day.

The horne of the seuen starres, whiche make the lesse beare.

Furthermore also you must make another peece, of the same substaunce of past or metal, in maner of a horne, in forme and order as are in heauen the seuen starres, whiche make the lesse beare: And this of such quantitie, that the first or formost guarde starre, may reache without the great rundell close to the circumference thereof, hauyng the North starre his center, with the center of the instrument. And from this starre or center vnto the fyrst and formost guarde starre, must be a ryght lyne, by the whiche the horne must be cut neare from the center, vnto the discouering

couerynge or shewyng of the houres. Also, from the fyrst guarde to the seconde, must be two partes of viene, of that that is from the Starre, whiche signifieth the North, to the fyrst guarde. Agayne, the seconde & last guarde, must be toward the left hand, ouer or aboue the fyrst, three quarter partes of one halfe Circle, which hath for the Semidiameter the two partes of viene, (whereof we haue spoken before) geuen vpon the right line that goeth from the North to the fyrst guarde. These two guarde Starres, must be boared through with holes, of the bygnesse of an Aglet of a poynt, and lykewyse the North Starre, with also the two rundelles through the center, and by that, al three peeces annexed, so that there remayne a hole in the myddest, lyke the holes of the guardes, so that by it, and by the other of the guardes, may be seene the Starres in heauen, in suche sorte, that the lesse rundell and the horne may be turned round about the Axis, as both appeare in the demonstration folowyng.

(***)



To fynde the houre with the inſtrument.

The inſtrument thus ended, and brought to perfection, when you deſire to know the houre, you ſhal turne the inder of the leſſe rundell in the which is written, Time, to that part of the great rundell where is marked the day in the whiche you deſyre to know the houre: and directyng your face towarde the North, you ſhal make the head toward the height of heauen, at the. 19. of

Apryll

Apryll. And seeyng in heauen by the hole in the myddest the starre of the North, holdyng the instrument in suche compasse of the face, that by the circumference of the greater rundell, may be seene the guarde starre in heauen, you shall turne the horne roumde about, vntyll it fall vppon the Guardes: so that by the two holes of the mouth of the horne, the two Guard starres may be seene, and by the hole in the myddest, the North starre, and all three with one eye: then the right lyne that goeth from the North to the fyrst Guarde, shall shewe in the lesse rundel, the houre that shalbe.

The. xviii. Chapter, of the tyme of Tydes, or rysyng and fallyng of the Sea.

GReat accompte ought Pilottes and Mariners to haue of the Tydes, to take Port, enter vppon Barres, passe by Flattes, and finally, for all maner of Nauigations. For beyng ignoraunt hereof, great hurt & inconuenience myght chaunce vnto them, as did of late to the valiaunt Captayne, Don Iohn Gusman the Earle of Niebla, in the yeere of. 1436. who was drowned before the Citie Gibraltar, for that the Mariners kept none accompt, neyther had consyderation of the Tydes. By reason whereof, not onely he was drowned, but also with hym dyed many worthy Gentlemen, and valiaunt Captaynes of Spayne.

The Mariners hold for a certaine rule, that the Moone being in the Northeast, or in the Southwest, is ful Sea: and being in the Southwest, or Northwest, to be lowe Water. They affirme also, that at the fyrst day of the newe Moone, the Sunne beyng at Northeast, and a quarter to the East (that is Northeast, and by East) the Moone shalbe Northeast, and then shalbe full Sea, and three houres, and three quarters.

The Mariners opinion of ebbyng and flowing of the sea, or tydes.

Obseruation of the Moone to know the tides.

And

And at the seconde day of the Moone, when the Sunne shalbe at East Northeast, the Moone shalbe at Northeast, and then shalbe full sea, and foure houres, and two quarters. &c. Theyr accompt is, that the Sunne beyng in the North, is mydnyght: and beyng in the Northeast, they accompte, three: and in the East, syxe. So that they accompte, three houres from wynde to wynde, by the eyght pryncipall wyndes, or lynes, whiche the Spauyardes call Rumbos. These wyndes must be imagined vppon the North, placed in the Angle, vnder, or beneath the Earth: and the Sunne and the Moone at the moouyng of the fyxt mooueable, and they ought not to be imagined in the Horizon, as the compasse sheweth. For speakyng by the tearmes of Astronomie, you must vnderstande, that the Moone touchyng in the circle of houres at the number of three, is euer full Sea: and touchyng in the same circle at the number of niene, is euer lowe water. No lesse ought they to obserue iuste accompt of the houres, by quarters of houres. For to geue. 30. dayes to the Moone, it shalbe necessarie to accompt by the fyftes of houres, as shalbe sayd hereafter.

Eyght principall wyndes.

Here is to be noted, that the Spanyardes thynke (be lyke) that a Northeast and Southwest Moone, maketh a full Sea in all other places, as it dooth in Spayne. But in that they be greatly deceyued, and therefore the rule that they haue set foorth for the Tydes, serueth onely for suche places where it floweth Northeast and Southwest Moone a full Sea.

And the better to vnderstande the increasyng and decreasyng of the Ocean Sea, it shalbe conuenient to knowe the cause thereof, whereunto we say, that the Moone is the cause of ebbyng and flowyng, or rysing and fallyng, increase or decrease of the Sea: not onely by her lyght, but also by her secrete or hyd propertie. The Moone compasseth about the earth, from the East into the West, vntyl she returne to the place or poynt from whence she departed: and in this course wasteth or spendeth so muche more then one naturall day, in howe muche her proper mouuing is more then the Sunne agaynst the fyxt moue-

The Moone causeth the ebbing & flowing of the Ocean Sea.

The mooouyng of the Moone.

able

ble, so that she maketh her turne or course about the foure quarters of heauen in. xxiiii. houres, and foure fyfthes of one houre, whiche are the twelue degrees that she goeth more then the Sunne. And in this tyme the Ocean increaseth and decreaseth twyse, so that this increasing and decreasing, answeareth directly to the course of the Moone: whereby it followeth, that the sea increaseth syxe houres and one fyfth part, and decreaseth other syxe houres, and one fyfth. And yf this day at the twelfth houre, was full sea, the lowe water shalbe at the syxth houre and one fyfth part: and at the twelfth houre and two fyfth partes it shall returne to be full sea: and at the syxth houre and three fyfthes, shalbe lowe water agayne: and at the twelfth and foure fyfthes of the other day, shalbe ful sea. So that from one day to another, the tyde doth shorten foure fyfthes of an houre, which is the time that the Moone slacketh or tarieth more then one natural day, to returne to the poynt from whence she departed by the twelue degrees, whereof we haue spoken. Whereby it manifestly appeareth, how they beguyle them selues that say, that the sea increaseth syxe houres, and decreaseth other syxe. For yf it were so, the tydes shoulde euer be at one selfe same tyme and houre. But for as muche as there is more then. xxiiii. houres, by the sayde foure fyfth partes, thereby is caused the variation of the tydes: so that if this day, the tyde be at one of the clocke, to morow it shalbe at one and foure fyfth partes, and the day folowyng, at two of the clocke and three fyftes. &c.

The shortenyng of the tydes.

An errour.

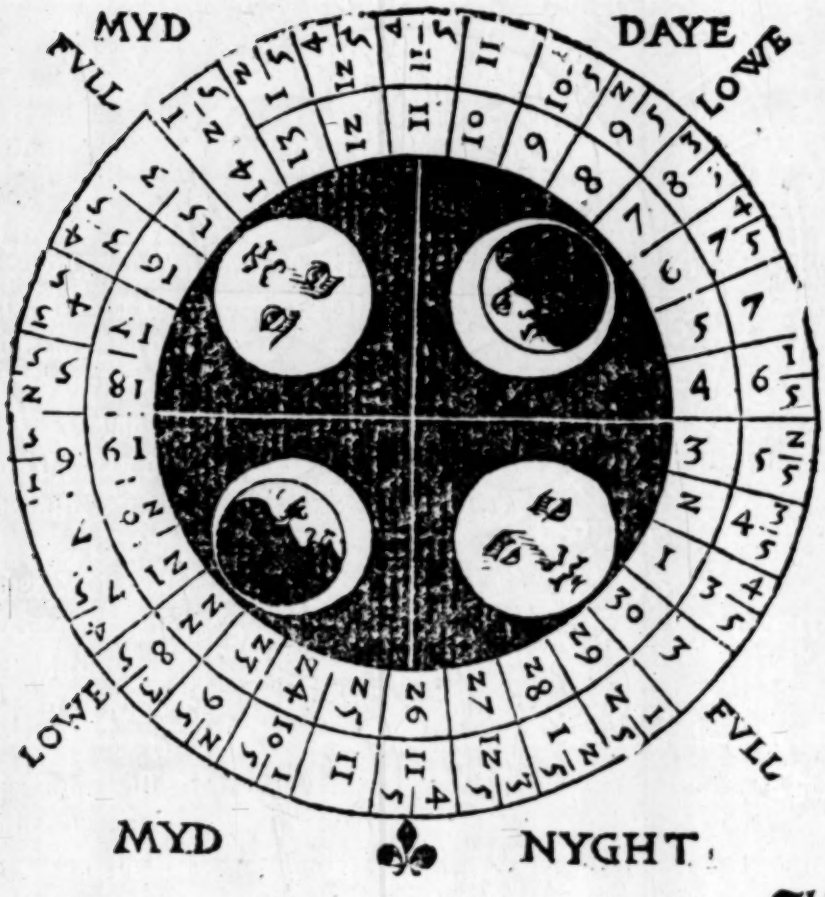
The variation of the tydes.

For this accompt, I wyl describe a Table in circular figure, although not precise, for the causes whiche we haue touched before in the fyfth Chapter, speakyng of the Moone: who sometymes in her mouing is swyft, and sometyme slacketh as much, because the coniunction is not euer in one selfe same poynt of the Zodiacke, as ỹ Mariners presuppose for their rule. This figure shall haue two circles, in the lesse (whiche shalbe the fyrst, and next vnto the center) shalbe the dayes of the Moone, from one to thirtie, which we count the coniunction. And in the seconde and greatest circle, shalbe founde the houres of the tydes. So that, who so desyreth to knowe when the tyde shalbe, where it floweth Southwest and Northeast, let hym at that houre take

A table to knowe the variation of the tydes.

heede to the dayes of the Moone, howe many they are: as if the be in the coniunction, or if it be the fyrst or seconde of the Moone. &c. And the day beyng knowen, then in the seconde circle whiche answeareth directly to the day, shall he fynde when shalbe hygh water, or full sea: and consequently, the ebbe, or low water, which shalbe syxe houres and one fyfth, after the full sea, and so lykewyse may he iudge when shalbe the halfe tyde: and this aswell at the tyme when it encreaseth (whiche shalbe three houres and halfe a fyfth part of an houre, before the full sea) as also when it decreaseth, which shalbe the halfe ebbe, three houres, and halfe the fyfth of one houre, after the full sea.

¶ The Table foloweth.



This

This increasing and decreasing of the Tydes, is not euer in equall quantitie. In the coniunctions and oppositions, they increase and decrease muche, which the Mariners cal hygh spring tydes, and the greatest increase of al, they cal the hygh springes. In the quarters of the Moone (which are at the .7. and .22. of the Moone, or neare there about) they increase and decrease but litle: which the Mariners cal nepe tydes, lowe water, dead waters, or lowe floodes.

The. xix. Chapter, of certayne signes, which prognosticate tempestes, or fayre weather.

A Good Pilot or Mariner, ought not to be ignorant of certayne signes or tokens, whiche the naturall Philosophers describe of tempestes. For as they signifie vnto hym, so shall he leaue his porte, or enter into it: whiche yf he canne not, then ought he with patience and hope, to tary the tyme that GOD hath appoynted for hym, who mooueth and troubleth the Seas, when it pleaseth hym, and appeaseth them agayne at his pleasure. Lesse hurteth and damageth the stroke whiche we see comming, or foresee, then that which hath stricked vs, and taken vs carelesse. When the Sunne ryseth fayre and cleare, it signifyeth a fayre day: but yf it shewe pealowe, or deadly, tempest is lyke to folowe. Agayne, yf at the rysing of the Sunne his beames shewe themselues contract, or geathered togeather, and short, you shall haue rayne: if the mistes or cloudes make a circle about the Sunne or Moone, how much the greater that circle shalbe, so much greater shalbe the tempest to come: and yf there shalbe two circles, the tempest shall increase the more. And yf it chaunce, that at the rysing of the Sunne the cloudes be turned redde, it is a signe of no small tempest. When the Sunne or the Moone shall haue a circle, looke towarde the part where it breaketh, and from thence shall wynde come: yf it depart, or dispearse equally, fayre weather shall folowe. When the Moone ryseth hygh and

shynyng with pure colour, you may iudge it fayre weather: and yf red, winde: yf blacke, rayne. When in the newe Moone, the hornes or corners appeare grosse or great, it is a token of tempest: and yf sharpe, it signifieth fayre weather.

The newe Moone.

This that we haue sayde, is the aucthoritie of Plinie and Aristotle, to whom the prudent Mariner shall credite, vntyll he haue found other, more certayne, eyther by his owne experience, or by the experience of other wyse men, woorthy to be beleeued. And euery man ought to trauayle as muche as in hym is, for the knowledge of these thynges, accordyng as God hath giuen hym vnderstandyng and reason to appoynt the same: and this shalbe wysedome, bearyng in memorie the experience of thinges past, to gouerne presently, and to prouide for thinges to come. The prouidence of God is so great, that depriuing brute beastes of reason and vnderstanding, he hath geuen them sense, and naturall instincte, whereby they may knowe that, that men do vnderstande by reason.

The sense of beastes, in foreseeing tempestes.

By this sense and secrete instincte of Nature, the Antes or Pismares, with prudence and diligence, lay vp in store theyr prouision and egges, when before they feele the rayne to come. The Swalowes also when they feele the Winter commyng, passe the Seas. Lykewyse the Fyshes, when they perceyue stormes to come, goe downe to the bottome of the water, and hyde them in the mudde of the Sea. And although it may seeme beside my profession, to meddle with matters parteynyng to Diuines, yet wyll I not omit to speake that Christe our Lorde sayth, as testifieth S. Matthewe. When the Pharisees with the Saduces (to tempt hym) wylled hym to shewe them signes from heauen, he answeared, saying, When it is euening, you say it shalbe fayre weather, because the heauen is redde: and in the morning, you say it shalbe tempest, when you see that the heauen draweth towarde redde. &c. They knewe by that they iudged of heauen, to determine thynges to come: as whether it were euyll to take iourney, to enter the Sea, to reape Corne, to lay it abroade, or to geather it in. I say, that to vnderstande the reason that moued them to haue suche consyderation of tyme,

Antes.

Swalowes.

Fyshes.

Math. xvii.

tyme (whiche we nowe lykewyſe obſerue) it is neceſſarie to knowe that the redde colour whiche appeareth in the euenyng, ſignifieth the dryneſſe of the ayre, whereby the matter of the groſſe vapours whiche ſhoulde be conuerted into the water, is ſo muche dryed, that it appeareth in maner inflamed, and is therefore red, and ſo is it not aptly diſpoſed to be conuerted into water, and is therefore the neareſt ſigne of fayre weather. The other ſigne when the heauen in the morнyng drawеth towarde reddeneſſe (yet not redde) ſheweth manifeſtly that rayne ſhal folowe. Whereof the cauſe is, that this matter is ingroſſed, becauſe this colour can not be but in groſſe and thycke matter, which is not dryed, and therefore is not redde, as the cloudes that appeare in the Weſt, in the tyme of fayre weather: but it is a matter ſomewhat troubled, and partly redde, and is therefore a confounded matter, which touched with the heate of the Sunne, and therewith broken and diſpearſed, falleth downe, and is conuerted into water. And further, as touchyng the ſayde troubled or groſſe water, I ſay, that the dry and ruddie parte thereof, is eyther turned into wynde, by dryneſſe, or els beyng compaſſed about, and incloſed with moyſte matter, is altogeather conuerted into rayne, and ſo maketh tempeſt. For by tempeſt in meant not onely rayne, but alſo tempeſtious wyndes, with water.

The redneſſe of the euening.

Ruddy the colour

What is tempeſt.

Lykewyſe it is wrytten by Saint Luke, When you ſee a cloude ryſe in the Weſt, you ſay rayne ſhall folowe: and when the wynde bloweth South, you ſay it wyll be hot, &c. To vnderſtande this, I ſay the cauſe of this is, that rayne is made or engendred of moyſt vapours, whiche both may be, & are ingroſſed. Or otherwyſe, a cloude is a groſſe body of moyſte vapours ſo ingroſſed, and when the cloude dooth ſo ryſe, it ſhalbe a ſigne that rayne ſhall ſhortly folowe: For that that was ingroſſed in the cloude, ſhall ſoone be reſolued into water. To the other reaſon, why they ſay that when the wynd bloweth South, it wyl be hot: I ſay that that wind is hot and dry. Furthermore it is to be conſydered, that the wyndes are ſometymes dry, and ſometymes moyſte, yet not by theyr owne propertie, but according to the re-

Luke. xii.

The generation of rayne or cloudes.

The qualities of wyndes.

gions by the whiche they paſſe. We ſee that in ſome one region it rayneth with one wynde, and the ſelfe ſame wynde in other places diſperſeth the cloudes. The Northweſt wynde is dry in Spayne, yet in Lybia it is very moyſt and rayny. The South wynde in Europe, cauſeth rayne in moſte places, and therefore the Poetes named it the wynde of waters, and this winde in Paleſtina or Iurie is dry. The cauſe of this diuerſitie, is, that when the wynde bloweth in Paleſtina, it paſſeth by hot and dry regions, as by the deſartes of Affrike, and paſſeth not by any ſea at al. But when it bloweth in theſe partes of Europe, it muſt of neceſſitie paſſe by, and ouer the waters of the ſea Mediterraneum, or the Leuant ſea, where it gathereth moyſture and cauſeth rayne. The Leuant or Eaſt wynde, in Malaga, and Gibralter, is moyſte, and in Sheres De la Frontera, is hot as Hell.

The. xx. Chapter, of the bright and ſhyning exhalations that appeare in the tempeſtes, whiche the Mariners call Santelmo, *or* Corpus ſancti.

IGnorance is the mother of errours, and therefore wyll I not omitte to ſhewe the naturall cauſe hereof, although among certayne ſimple and ignorant people, it is accounted for a myracle, that in certayne tempeſtes on the Sea, the Maryners ſee certayne ſhyning and bryght fyres, whiche with great ſuperſtition they kneele downe vnto, and pray vnto, affyrmyng that is is Santelmo that appeareth vnto them, & not contented herewith, ſome ſweare that they haue ſeene drops of greene waxe fal downe. Other affyrme that this waxe is of ſuch heate, that if it fall from the toppe of the ſhyppe, it dooeth melte the roſen and pitche of the hatches of the ſhyp, with ſuche other foolyſhe imaginations, and therefore it ſhalbe good briefly to ſpeake hereof, to ſtoppe

Some cal theſe the fiers of S. Elin and S. Nicolas.

stoppe the mouthes of suche fonde and ignorant persons. The exhalations or vapoures of the grosse fumes or smokes that ryse from the earth, are constrayned or geathered togeather by the coldnesse of the nyght, and the ayre, and are thickned in the fyrst region of the ayre, next vnto the earth. This may, and is wont to be inflamed or kyndled, and yf it finde a body whervnto it may cleaue, it abydeth in that vntyll it be consumed. This fyre is cleare, and shyneth, and yet burneth not. The Greekes call it Polyduces, and the Latines call it Castor and Pollux. It is accustomed to appeare vpon the shrowdes, and oftentymes is seene vpon the pykes of souldyers, in the armies of men of warre, as Plinie wryteth, and this, aswell by reason of continuall smoke, as also by the heate of muche people. Certayne it is, that smoke is none other thyng then fyre dispearsed: as flame is an exhalation or euaporation that ryseth in maner of smoke, from a grosse or fat body, and at the tyme that it ryseth, beyng geathered togeather, is constrayned into flame, inuestured with fyre. This resplendence or shynyng, is also often tymes seene, not onely in iourneying by lande, but also in saylyng by ryuers: and when it appeareth on the lande, it ryseth of the smoke that is geathered togeather with the colde ayre of the nyght, and on the bankes of ryuers: this smoke is geathered of the exhalations of the water, and consequently beyng kyndled, appeareth bryght and shynyng. But nowe let vs come to the shyppes that sayle by the Sea, and to the Mariners that are accustomed to tempestes. To them therefore I say, that that lyght, or suche other lyghtes as they see, is engendred of the fumes and smokes of theyr Shyppe, with the heate of men couched close and neare togeather in a narrowe place, and when a tempest ryseth, the sayde smoke is thickned, prest togeather, and beaten downe by the wyndes, in suche sorte, that beyng tossed from one syde to another, it is set on fyre by mouyng, and taketh holde sometyme on the shroudes, and sometymes on the toppe, and sometyme also in the poupe, or in the forshyppe: So that to see this lyght, or the same to appeare, is a naturall thyng, and not supernatural.

Wandring fyers engendred of exhalations and vapours.

Castor and pollux.

What is smoke and flame.

Exhalations of the land & water.

Exhalations and vapours engendred in shyppes.

When Captayne Bezerra was at Coyron, in the Emperours Name, with his company of Souldyers, he chaunced to be in a tempest, and sawe the sayde fyre of San. elmo, whiche shortly after descended so lowe, that the Captayne myght easily come to it: and takyng it in his cloke, he iounde it to be a litle droppe of water. Some haue thought it to be a certayne shyning Flie, called Taros, whiche the sea men some time see in a calme in the Sommer season: and thus Santelmo appeared no more. The Captayne remayned astonished at the mockerie, and the other perceyued it to be no miracle. The opinion of the Maryners that affirmed it to be Santelmo, may ryse of Sainct Erasmo, Bishop of Naples, who (as they say) not only in his life time, but also after his death, was a patrone and helper of Mariners that called vpon hym in tempestes. This name of Erasmo, they of Naples call Ereemo: and processe of time taking away one e. by the figure of Sincope, remayned the name of Santermo. And the Spaniardes, who neuer can long keepe any strange vocable, call it Santelmo, turning r. into .l. Yet of this Santelmo, whereof the Maryners speake, there is neyther scripture that maketh mention, nor auctoritie that confirmeth it. I heare say that the Frier preachers hadde a religious man, of commendable life, and good conuersation, named Frier Pero Gonzales, borne in Galizia, and that in his lyfe time our Lorde dyd certayne miracles by hym, and that this is he that shyneth and geueth lyght in tempestes. No doubte, but GOD worketh myracles in his Saintes, and by his Saintes, as sayth Dauid. Psalm. lxvii. But yf this seruant of GOD was Pero Gonzales, howe then shall he be Santelmo? Another difficultie there is, as touching this lyght: for there are wrytynges of more antiquitie then the lawe of grace and commyng of Christe in flesh, whiche geue testimonie hereof. For the Poet Uirgyll, in the second of his Aeneidos, wryteth, that this fire appeared vpon the head of Iulius Ascanius And Titus Liuius in his first booke, affirmeth, that it appeared vpon the head of Seruius Tullius, the sixth Kyng of the Romanes.

A shining fye

A superstitious opinion of the Mariners.

A lye of the fryer preachers

Psalm. lxvii. Testimonie of auncient auchours.

Pom-

Pomponius Articus sayth, that Rome beganne to be buylded in the thyrde yeere of the thyrde Olimpiades, that is, in the tenth yeere of Ionathan kyng of the Iewes, and from the creation of the worlde. 3201. yeeres, and. 729. yeeres before Christe our Sauiour was borne. The kynges of Rome were seuen, and raigned. 244. yeeres. Eusebius sayth, they raigned. 246. Seruius Tullius raigned. 44. yeeres, Tarquinus superbus. 25. yeeres after hym. So that discountyng these yeeres, it shall appeare clearely as I say. Although the yeeres were not discounted, let them reade Diadorus Siculus, an auncient wryter, let them reade Plutarchus, Aristotle, and other olde Aucthours that haue wrytten hereof, and they shall fynde, that yf tempestes be neare vnto the Sea, these fyres and lyghtes appeare in them: and appeared not onely to the Gentiles, but at this day also appeare to the Turkes and Moores in tempestes. When onely one lyght appeareth, it is taken for an euyll signe: And hereof sayde Propertius thus.

The buyldyng of Rome.

The Romane Kinges.

Candida fœlici soluite vela toro.

And why it is an euyll signe, this is the cause: that if the tempest that ryseth be great, it choketh the exhalation, although yet by the part leaste troubled, it appeareth. When there are two lyghtes, it signifyeth that it is sufficient to consume the matter of the tempest, or that the tempest beginneth to ceasse, and the grosse humour hath the maisteric. But sometyme it chaunceth, that two lyghtes appearyng, there may be a tempest, and one appearyng shall not be so great, and often tymes there is a tempest without any lyght at all seene. The blynde Gentilitie called these Castor and Pollux, and placed them in heauen in the signe of Gemini.

One lyght or fyre is an euyll signe.

Two lyghtes.

Castor and Pollux.

Nowe remayneth to aunsweare to one obiection of the Marriners, who say, that neuer man that hath seene these Fyres, hath perysshed. To this I say, that many may see, and haue seene these lyghtes, of whom, some haue been in peryll, and some drowned: Notwithstandyng, no man can affirme,

An errour of the Mariners.

firme, that yf the drowned myght speake, they woulde say that they haue seene them. Therefore the wyse Christian Maryner ought to haue a cleare conscience, and to call for the helpe of almightie GOD, lyfting vp his eyes and handes vnto heauen, and say with the Prophet, Saluum me fac Deus, quoniam intrauerunt aquæ vsque ad animam meam. Saue me, oh my God, for waters haue entred euen vnto my soule.

Psalm. Lxviij.

(***)

Here endeth the second part.

The thyrde part, entreateth of the composition and vse of Instrumentes, and Rules for the Arte of Nauigation.

The fyrst Chapter, of the number, order, and names of the wyndes.

SO greatly estemed was Eolus, kyng of the Eolas Ilandes, or Ilandes of Vulcane, for hauyng reason and knowledge of the wyndes, that they of auncient tyme called hym the god and lord of them. With no lesse consyderation, the prudent Paryner ought not to be ignorant of them, for as muche as the vniuersall benefite, and commoditie of Nauigation consisteth therin. And to haue the better knowledge thereof, you shal vnderstande, that wynde is fruite of the ayre, and vapour of the earth: the which by reason of his subtiltie, pearceth the ayre, striketh it, and enforceth it. Other say, that wind, is ayre, moued or tossed by the vehement influence of vapours of contrarye qualitie. It is in Latin called Ventus, because it is vehement, and violent, whose force is so great, that it ouerthroweth not onely heapes of stones, or rockes, and casteth downe trees: but also disturbeth the ayre and the earth, and moueth the seas. There are foure pryncipal wyndes, which come from the foure cardinall or principall poyntes of the Horizon. We haue sayd that the Meridian circle, cutteth the Horizon in two poyntes (that is) in the North and in the South, and the Equinoctial cutteth it in other two, that is, in the East and West, and from these foure poyntes come these foure wyndes, whereof al the whole Scripture maketh mention. These foure wyndes, they in auncient tyme, named in this maner. That that commeth from the East, they called Subsolanus, whiche we call the Leuant, or East wynde.

Why Eolus was fayned God of windes

What is wynde.

The foure principall or Cardinall. wyndes.

Luke. xvii.

East.

That

South. West. That commeth from the South, they named Auſter, whiche we call the Meridian, or South wynde. That commeth from the Weſt, they call Faucinus, whiche we call the Ponent or Weſt. That from the North they named Septentrio, or Aquile, or Boreas, whiche we call North. To euery of theſe foure wyndes, they adioyned two collaterall wyndes, in maner as foloweth. That that is from the Eaſt towarde the parte of the North, where the Tropike of Cancer aryſeth, or cõmeth forth, they called Vulturnus: and that that is from thence towarde the part of ỹ South, where ryſeth the Tropike of Capricorne, they called Eurus: alſo that is from the Weſt towarde the part of the South, where the Tropike of Capricorne goeth downe, they cal Aphricus: & that that declineth to the North, where the Tropike of Cancer goeth downe, they cal Caurus. The Collaterals of the North and the South, anſwereth to the circumferences of the Polar circles: that that is from the North towarde the Leuant, or Eaſt, they call Aquilo: and that declineth towarde the Weſt part, they cal, Circius: that is from the South toward the Eaſt, Euro Auſter, and towarde the Weſt, Euro Aphricus: thus many hath Ariſtole in his Methoza. With theſe .xii windes, they ſayled in old time, & made their compaſſe by them.

Collaterall wyndes.

Twelue wyndes.

The Hydrographers of late dayes, & ſuch as are trauayled & exerciſed in ſaylyng, agree with the auncients in the foure principal wyndes, although they haue chaunged the names, callyng the Leuant, or Orient, Eaſt: ỹ Ponent or Occident, Weſt: th Septentrional, North: and the Meridional, South. Betweene theſe foure windes, they deuide euery quarter of the Horizon into two halfes, made of the two neareſt, in this maner. Betweene the North and the Eaſt, takyng name of them both, they name the Northeaſt. Betweene the Eaſt and the South, they name the Southeaſt: and betweene the South and the Weſt, Southweſt: beweene Weſt and North, Northweſt. Theſe eyght wyndes in nauigation, they call whole wyndes.

Eyght whole wyndes.

Diuiſion of the Horyzon by the foure principal wyndes.

Betweene theſe eyght wyndes, they place other eyght, that are called halfe wyndes, whiche alſo are named of the two that are neareſt vnto them. That that is betweene the North and Northeaſt, they call Northnortheaſt,

Eyght halfe wyndes.

betweene

Betweene North East, and is East Northeast: and so forth of the other. Beside these halfe windes, they haue other which they call quarter windes. These take the name of the windes to the which they declyne: as yf to the quarter from the North, towarde the Northeast, they call it North, and a quarter towarde the Northeast, that is, North and by East. And that that is towarde the Northwest, they call North, and a quarter towarde Northwest. And so of the other, as shalbe verified in the figure folowyng: whereof is gathered, that deuidyng the eyght principall wyndes into halfe wyndes, they are. 16. And euery halfe wynde deuided into two quarters, are in al. 32. wyndes. Some haue been so curious, or rather so vaynely carefull and too precise, that they haue deuided them into. 64. And in the Cardes that they haue, the confusion of lynes is greater, then the profite that may be taken thereby.

Quarter windes.

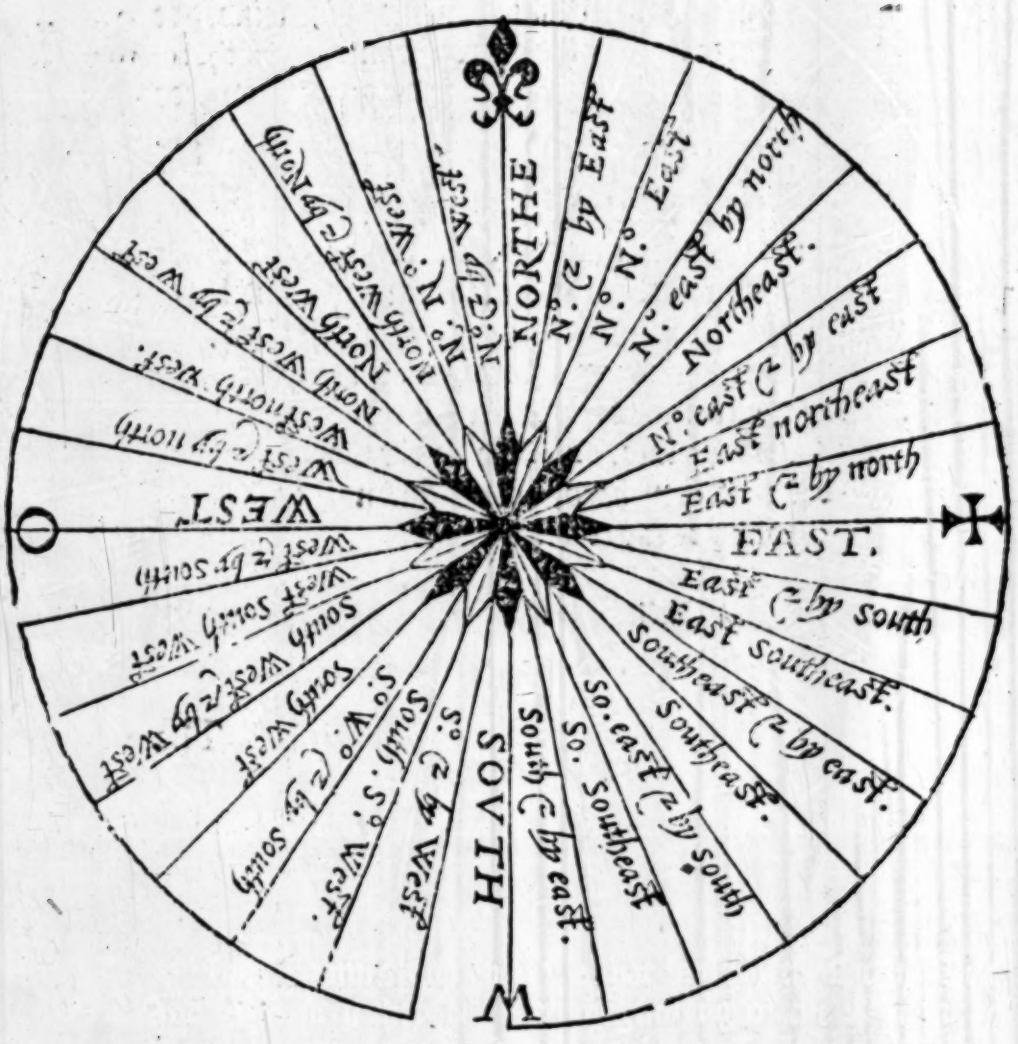
The deuision of the windes.

Xxxij. windes in all.

(**)

The

The demonstration of the wyndes.



The names of the windes in the Italian or Tuſcane tongue.

Theſe names doo they vſe that ſayle by the Ocean Sea. And it ſeemeth they had their beginnyng of the Almaine or Flemiſh tongue: For theſe nations chiefely ſayle in the Ocean. They that ſayle in the Sea Mediteraneum, or Leuant Sea, cal them by other names, taking originall of the Tuſcan or Italian tongue. Or els that they haue denomination of the partes from whence they come, in reſpect of the Sea Mediteraneum, as the wynde called Græco, becauſe it commeth from Grecia, and Libeico,

Libeico, because it commeth from Lybia, and Syroccho, because it commeth from Syria, and begynnyng at the North, these are their names, Tramontana, Græco, Leuante, Ponente, Maestro, and that that is betweene Tramontana and Græco, they call Græco Tramontana, and that is betweene Græco and Leuante, they call Græco Leuante, and that is betweene Leuante and Syroccho, they call Leuante Syroccho, and that is betweene Syroccho and Mezzo Iorno, they call Mezzo Iorno Syroccho, and so of the other: and the lyke of the quarters. And because they that saple in the Ocean, are gouerned by altitudes, we wyll vse the names that they vse, where we intende to intreate of altitudes, and euery man shall vse them as he lysteth, for as much as the difference is not in the windes, but onely in their names.

The seconde Chapter, of the composition of Cardes for the Sea.



Rriuyng to the ende desyred (whiche is Nauigation, the principall intent why I began this worke) I say, that Nauigation or Sayling, is none other thyng then to iourney, or vyage by water, from one place to another, and is one of the foure difficultest thynges, whereof the most wyse king hath written. These viages do differ from viages by land, in three things: for the lande is fyxme and stedfast, but this is fluxible, wauering, and moueable. That of the lande, is knowen and termined by markes, signes, and limities: but this of the sea, is vncertayne and vnknowen. And yf in viages by lande, there are hylles, mountaines, rockes, and craggie places, the sea payeth the same seuen folde with tormentes and tempestes: therefore these viages beyng so difficult, it shalbe harde to make the same vnderstoode by wordes or wryting. The best explication, or inuention, that the wittes of men haue found for the manifesting of this, is to geue the same payncted in a Carde.

What is Nauigation.

Prouerb. xxx.

The daunger and difficultie of Naulgation.

For

Making of Cardes for the Sea.

For the draught, or makyng whereof, it shall be requisite to know two thinges: whereof the one is, the right position of places, or placing of countries and coastes. The other is, the distances that is from one place to another, and so the Carde shal haue two descriptions. The one that answeareth to the position, shalbe the wyndes, whiche the Mariners call lynes or poyntes of the compasse: and the other that answeareth to the distances, shalbe the drawyng and poynting of the coastes of the land, and of the Ilandes compassed with the sea. To poynt the wyndes, or lynes, you must take skynnes of Parchment, or large Paper, of suche bygnesse as you wyll the Carde to be, and in it drawe two ryght lynes with blacke inke, whiche in the middest shall cut or deuide them selues in ryght angles, the one accordyng to the length of the Carde, which shalbe East and West, and the other North and South. Uppon the poynt where they cut, make a center, and vppon it, geue a priuie or hid circle, whiche may occupie in maner the whole Carde. This circle, some make with lead, that it may be easily put out: these two lynes deuide the circle into foure equall partes, and euery part of these shal you deuide in the myddest with a pricke or puncte. Then from one puncte to another, drawe a ryght Diametrall lyne with blacke incke: and so shall the circle remayne deuided with foure lynes, into eyght equal partes, which corresponde to the eight windes. In like maner shal you deuide euery of the eight into two equal partes, and euery part of these is called a halfe wynde. Then drawe from euery puncte, to his opposite Diametrall a ryght lyne, of greene, or azure: lykewyse shall you deuide euery halfe wynde in the circle, into two equall partes. And from these punctes, which deuide the quarters, you shall drawe a certayne ryght lyne with redde inke, whiche also shall passe by the center, whiche they call the mother Compasse, or chiefe compasse of the Carde, beyng in the myddest thereof: and so shall come foorth from the center, to the circumference. 32. lynes, whiche signifie the. 32. windes. Beside these sayd lynes, you shall make other equal distant to them, and of the selfe same colours, in this maner. From the poyntes of the wyndes and halfe wyndes that passe by the center, drawe certayne ryght lynes, that passe

The wyndes or lines are called Rumbos, in the Spanyshe tongue.

The mother compasse of the Carde. 32. lines which signifie so many windes.

not

not by the center, but be equally distant to those that passe by the center, and of the same colours and equidistance, as are they that passe by the center. And as these lynes concurre togeather aswell in the center as in the poyntes of the wyndes, and halfe wyndes, that are in the circumference of the circle, they shall leaue, or make there other syxteene compasses, euery one with his thyrtie and two wyndes. And yf the Carde be very great, because the lynes may not goe farre in sunder, yf you wyl make there other syxteene compasses, you must make them betweene the one and the other of the fyrste syxteene poyntes, where the quarters are made with theyr wyndes, as we haue sayde. It is the custome for the most part, to paynt vpon the center of these compasses, a flowre, or a rose, with diuers colours, and gold, differencyng the lynes, and markyng them with letters and other markes: especially signyng the North with a flowre Deluce, and the East with a Crosse. This beside the distinction of the wyndes, serueth also for the garnyshyng of the Carde. And this for the most part is done after that the coast is drawne. And thus muche suffiseth for the draught of the wyndes.

The placyng of many compasses in the Carde.

The flower, or rose of the center.

The North.

The situation of the places, Portes, and Ilandes in the Carde, accordyng to theyr proper differences, consysteth in the particuler, and true relation of suche as haue trauayled them, and therefore for this purpose it shalbe needeful to haue paternes of costes, portes and Ilandes, whiche must be paynted in the Carde, and these of the best & most approued to be true: and not only to haue paternes wel paynted, but also it shalbe necessarie to know the true altitudes of the Pole, of certayne principal Capes, Portes, and famous Cities. This doone, they must be translated into certayne thinne papers, and transparent, that may be seene through, and those of the best and finest that may be had, annoyntyng them with oyle of Line seede, and then dryng them at the Sunne. Then take the paterne or Card that is to be translated, and reache or stretche it fourth vpon a table. Then put the transparent paper, vpon the one side of the paterne where you wyl begyn. And the paper being made fast vpon the

The situation of the place. &c.

Translation of the Card, from one to another.

paterne with plomettes of leade, or a lytle waxe, that may eastly be taken of, you shal in the transparent paper marke with a fine penne, one East and West, and one North and South, or two, vpon those that are seene by the selfe same paper in the paterne. And this is called tracyng, or translatyng. In lyke maner shall you trace all the costes, heauens, portes, Ilandes, cities, Capes, and riuers, as appeareth in the paterne, vnto the rockes that come foorth of the water, and the knowne bankes. And because this paper dooth not suffice, you shall put thereto another, and more, as neede shal require. And begyn the translation in one, where the other endeth, vntyll you haue translated all that you desyre, not forgettyng to make in euery one, lynes of North and South, East and West, to serue for markes afterward. So that the lyne of North and South, of the one paper, may ioyne close and euen, with the lyne of the North and South of the other paper that is ioyned to it by longitude.

And the paterne thus translated into these papers, you muste put the ruled or lyned paper or papers vpon a playne, smoth, and stedfast table, where you shall stretche them foorth, and make them fast with plomettes or weyghtes, or nayle them to the table by the sides or corners, with small nayles. Then vpon the sayd ruled paper, you shall put the paper that is translated from the paterne, in that side or part that is correspondent from ỹ paterne, to the ruled Carde, so that the lynes of East and West, North and South of the translation, may be vpon the lynes that answere to them in the ruled Carde.

This paper thus made faste by the one syde or part, you shall by the other syde (that it may remayne in his place) put vnder it an other fyne paper, smoked or smyred on the neathermost parte (whiche is that, that falleth vppon the ruled Carde) eyther with a lynke, or with matches of pitche. These thus ordered, and made fast one vppon another, you shall take a steele bodkyn, or wyre, with a smoothe and blunt poynt, that it race not, or bore not the paper, and with it shall you drawe, pressyng vppon all the translation, and tracyng it with diligence

Some doo this only with oyle.

Tracyng of the Carde.

and

and discretion, marking euer how much in it is translated from the paterne: lauyng the wyndes or lynes whiche the Maryners call Rumbos, and so shal remayne al the impression of the smoke in the ruled Carde, vppon the whiche, with a fyne penne you shal trace with ynke: which beyng dyde, you shal with crummes of breade make it cleane from al the smoke, and so that the coaste appeare in the Carde drawne with ynke.

This doone, then with a small penne shal you describe in the Carde, al the places and names of the coaste in that parte where they are, and as they are seene in the paterne. And first you must describe in redde, the Portes, principal Capes, famous Cities, with other notable thynges: and all the residue in blacke. Then shal you drawe or paynte Cities, Shyppes, Banners, and beastes, and also marke the regions, and other notable thynges. Then with colours and golde shall you garnyshe and beautifie the Cities, Compasses, Shyppes, & other partes of the Carde. Then shall you set foorth the coastes with greene, by the shores or bankes of the landes, and make them fayre to syght with a litle saffron, or otherwyse, as shal seeme best. Lykewyse shal you describe certayne letters, with theyr significations, in this maner. The paynting of the Carde.

B. for a Bay. C for a Cape. A. for an Angle. I. or Y. for an Islande. M. for a Mountayne. P. for a Porte. R. for a Ryuer.

Then in place where is more roome, or that is least occupyed, you shal drawe two ryght lynes, equally distaunt: and the one no further from the other then halfe a finger, or litle more: and so long, that betweene the may be marked at y least three hundred leagues. And this the Maryners cal the trunche or scale of leagues, and place it or vse it in this maner. They take with y compasse, a hundred leagues of y trunke of the Carde or paterne that is translated, and they set them full betweene the two lynes, and this space they part by the halfe, and reste the foote of the compasse in .50. and these deuided agayne equally in two partes, they reste the compasse in .25. and the .25. beyng lykewyse deuided, The making of the trunke or scale of the leagues.

they rest in .xii. leages and a halfe, and marke them as appeareth in the demonstration folowyng.



The graduation of the Carde.

The carde beyng thus made, then to graduate it, or diuide it into degrees, you must drawe three lynes, whiche make ryght angles with the lyne of East and West, equidistant to the lyne of North and South: and they also shalbe North and South. These shalbe drawne by the Ilandes of Asores, or Soria, or nearer to Spayne, or where the Carde shalbe lesse occuppyed. And for this purpose, the one lyne must be so farre distant from the other, that in the two spaces which they make, may be marked, in the one, the degrees, & in the other, the number of them, conformable to the graduation of the paterne: as the numbers of degrees shewe East and West, with the portes, capes, and coastes in their proper altitudes.

And if the Carde haue no graduation, you shal take with the compasse in the trunke of the leagues, seuen spaces of .12. leagues and a halfe, whiche are .87. leagues and a helfe. And these must be deuided into fiue partes, which come fourth at .17. leagues and a halfe for a parte: and the foure partes taken with the compasse, make foure degrees, and deuided into foure partes, euery part is a degree, and is marked thus. o

The marke of a degree

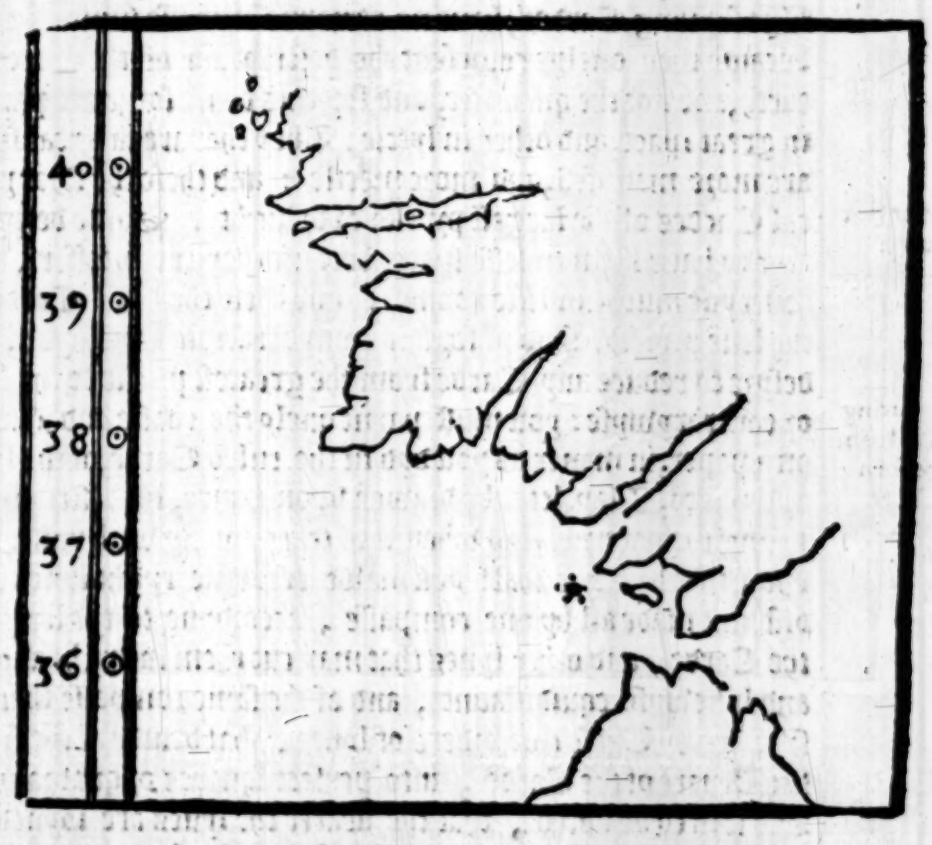
And yf you wyl make the degrees at .16. leagues, and two terces or more: you shal geue to euery degree so muche space as the leagues comprehende. This graduation must be begun from some one cape, whose altitude of the Pole is well knowen. And the whole Carde beyng thus graduate, you must begin the number of the degrees from the Equinoctial lyne, one, two, three. &c. towarde the one Pole, and the lyke towarde the other: so that to the knowne Cape, may answeare the number of his altitude. And so shall you doo to the whole Carde. Also, the Equinoctiall lyne shalbe marked in his proper place.

And

And in lyke maner shal you marke the Tropikes accordyng as they are in the sphere. But forasmuch as in Spayne, Cape saint Vincent is the principal, they begyn there to make graduation, & number it in .37. degrees. And from thence, toward the Pole Artike, the degrees do encrease. And from thence towarde the Equinoctial line, they diminishe: and from that lyne, to the pole Antartike, they encrease agayne (as we haue sayd) as is conteyned in the Carde, and as appeareth in this demonstration folowyng.

Cape. S. Vincent.

Increasing & diminishing of the degrees.



And yf the paterne haue neyther leagues nor degrees, you must take or knowe the altitudes of two Capes, that are North, and South, of the degrees, and the difference of the degrees of the eleuation, that is from the one Cape to the other, ye shal deuide al that space in so many partes, and so eche one parte shalbe seuenteene leagues and a halfe, as answereth to one degree.

If the paterne haue neyther league nor degree.

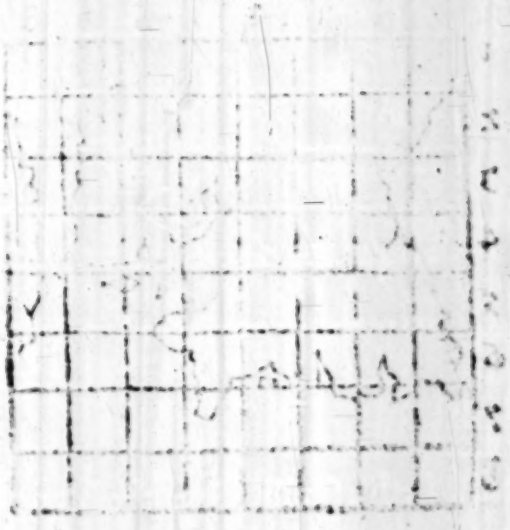
gree. Or accordyng to the opinion of the leagues of the roundenesse of the earth, as we haue sayde, as touchyng this in the eyghteenth Chapter of the fyrst part. In Spayne they vse with the compasse to take the space that is from Cape Saint Vincent, to the myddest of the greatest Ilande of Berlinga, whiche they account three degrees: so that after seuentene leagues and a halfe for a degree, they are 52. leagues and a halfe: and so much do they put in this space. Other put fyftie leagues, accomptyng after syxteene leagues, and two tertes for a degree, and in this maner they make of leagues, degrees, and of degrees, leagues. The saylyng Cardes, haue no certayne bignesse limitted them, because they onelye represent the description of the water and earth, and not the quantitie, and for this cause some are paynted in great space, and other in lyttle. They that are in great space, are more manyfest, and more precise: and these the Mayners call Cardes of the largest pycke or draught. Some desyre rather to haue them in lesse space, because they are briefer, and conteyne muche in litle roome: and these they call Cardes of the lesse pycke. And yf for any consyderation aforesayde, you desyre to reduce any Carde from the greatest pycke to the least, or contrarywyse: you must paynt onely the coaste and Ilandes on a paper, in maner as you dyd in the ruled Carde, of the lynes or wyndes, I say, let it be drawen vpon paper, for destroying or rasing the paterne. And when it is traced onely with yncke, then vpon that draught shall you drawe certayne ryght lynes equidistaunt made all by one compasse, accordyng to the length of the Carde, and other lynes that may cut them in ryght angles. and lykewyse equidistaunt, and of the same compasse that the fyrst are. These two orders of lynes, shal deuide al the superficiall part of the Carde, into perfect squares or quadratures. And it is to be noted, that the neater the lynes are ioyned togeather, and the squares the lesse, so muche the more perfectly may it be reduced, and more easily. Then shall you take another paper, greater or lesse then the Carde, accordyng to the poynt that you desyre to reduce it vnto, and in the length and breadth thereof, you shall deuide so many spaces as are betweene the lynes of the other paper, and yf it be

The quantitie of Cardes.

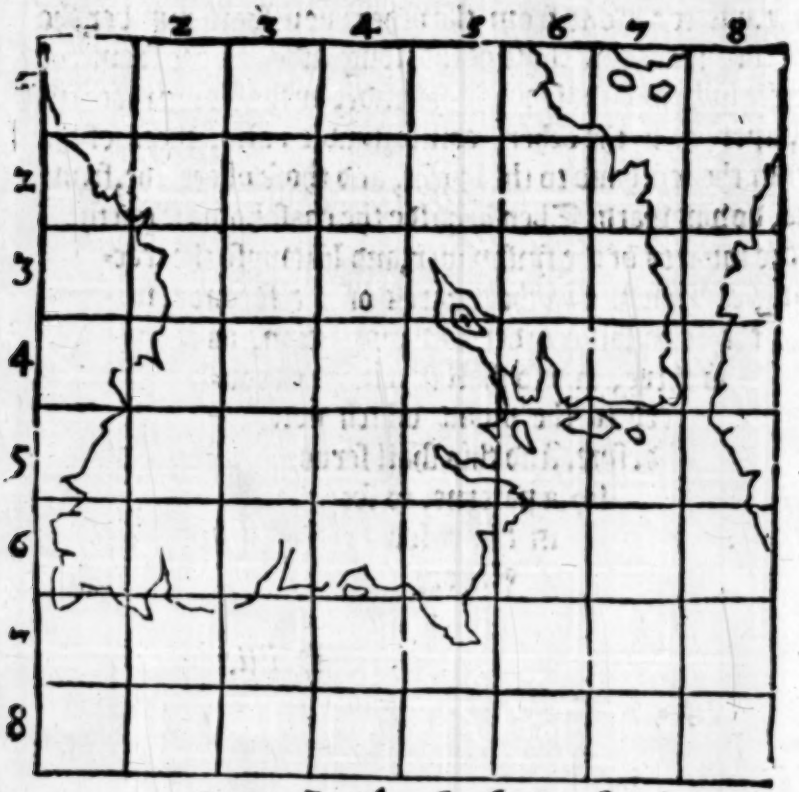
The reducing of Cards from a bygge forme to a lesse, or the contrary.

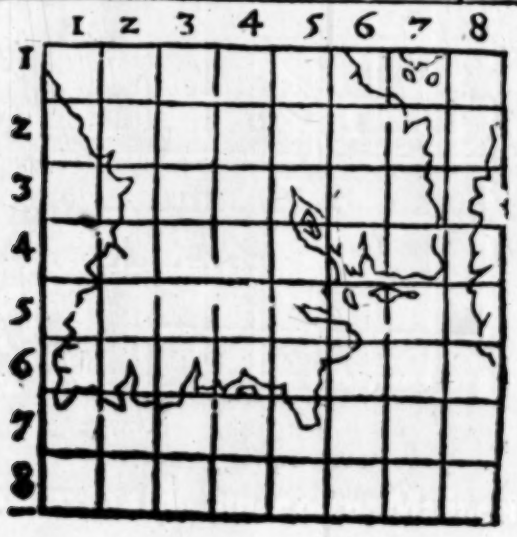
greater

greater, the squares shalbe greater: and yf lesse, lesse. To kepe order in the correspondence of the squares (which shalbe a great lyght to translate the one from the other) you shall number the orders of the squares, as those of the longitude, by the fronte or uppermost part: and those of the latitude, by the syde, as well in the one paper, as in the other, conformable: also, those of the front, from the left hand to the ryght, and those of the syde, from aboue, downeward. Then beholde the coast howe it goeth by the squares of the fyrst paper, and likewyse the tracting or drawyng in the squares of the seconde, in the selfe same order and proportion, as it is there, and so shall it remayne reduced to the poynt which you desyre. And this shall serue for a paterne, to set in the ruled Carde.



Here foloweth the maner of the translating of the Carde from one fourme into another, greater or lesse.





Here foloweth a similitude of the Mariners Carde.

The playne Cardes are imperfecte.

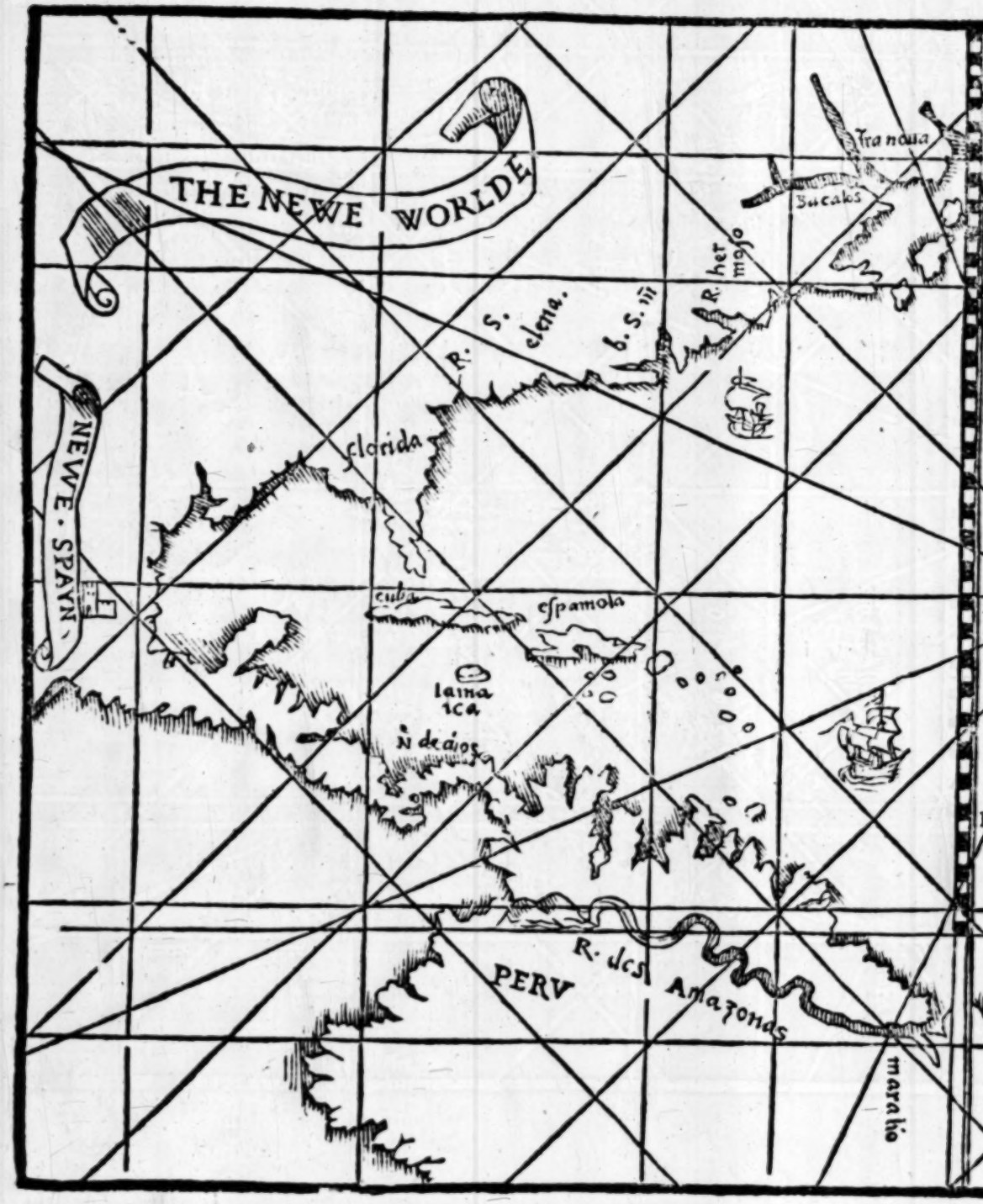
Example of errour in the playne Cardes.

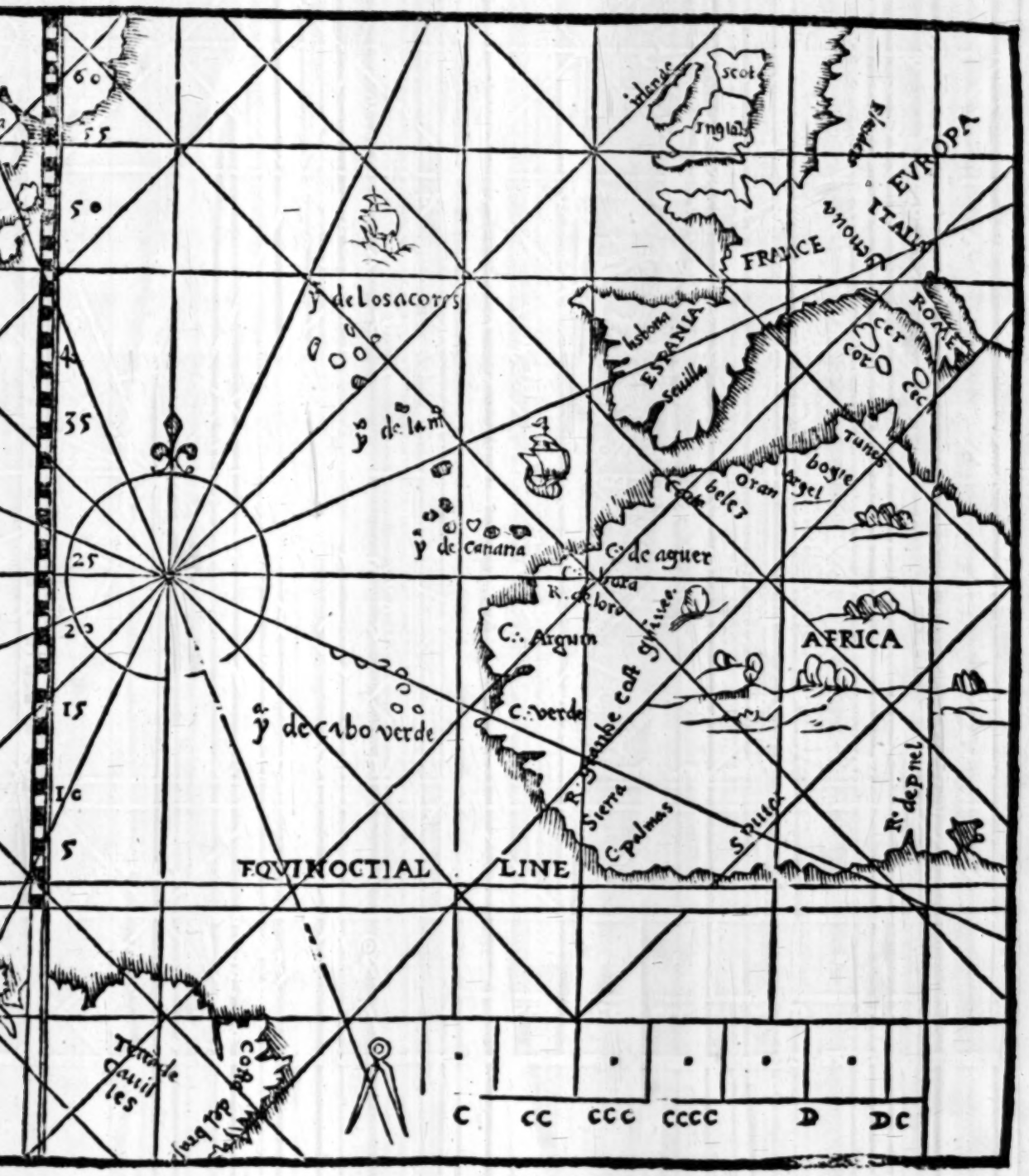
The ignoraunce of certayne Pilots.

Good Cardes.

The variation of the compasse.

Altitudes.


THE NEWE WORLDE
NEWE SPAYN
Tranoua
Bucalos
R. her moso
b. S. iii
R. S. elena.
florida
cuba
espamola
Iamaica
N de aios
R. des Amazonas
PERV
marahio


60
55
50
45
40
35
30
25
20
15
10
5
irlande
scote
Inglat
EVROPA
ITALIA
FRANCE
ESPANIA
Seuilla
Tunez
bogie
argel
Oran
belez
C. de aguer
AFRICA
C. Arguin
C. verde
C. palmas
Sierra
R. de nel
EQVINOCTIAL LINE
C
CC
CCC
CCCC
D
DC

H

2

3

4

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6

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8

H

The pilots and Mariners neither vse nor haue the knowledge to vse other Cardes, then onely these that are playne, as I haue sayde. The whiche, because they are not Globus, Spherical, or rounde, are imperfecte, and faile to shewe the true distances. For in howe much they departe from the Equinoctiall, toward whiche so euer of the Poles, the Meridian lynes are contracte narower and narower: In suche maner, that yf two Cities or poyntes in the Equinoctial, shoulde be distaunt of longitude. 60 leagues, and in the selfe same Meridian at. 60. degrees from the Equinoctiall, towarde eyther of the Poles, shoulde be other two Cities or poyntes, they shoulde be distaunt in longitude but onely. 30. leagues. And for the better declaration and vnderstandyng hereof, I say, that yf two shyppes shoulde departe from the Equinoctiall, the one distaunt from the other a hundred leagues by East and Weast, and that eyther of them shoulde sayle directly by his Meridian towarde the North: then when eyther of them hath the Pole ouer his Horizon. 60. degrees, the one shalbe distaunt from the other onely. 50. leagues by the Paralelle of East and Weaste, as appeareth by the playne Cardes, that they haue the selfe same hundred leagues. And beside these considerations, one erroꝛ bringeth in an other, & so another an other. Whereof to speake any more here, it shalbe to certayne Pilots (as ỳ prouerbe saith) not onely to geue muske to the deafe, or to paynt a house for blynde men, but shal also be an endeleſſe confusion. Furthermore it is necessary to consyder, that good Cardes ought to haue the Coastes, Ports, Cities, and other places, situate accordyng to the wyndes or lynes thereof, proportionally as they are in the worlde: and not by the wyndes that the compasse sheweth. This I say for the Northeastyng or Northwestyng of the compasse (called the variation) as hereafter I wyl touche in the fyfth Chapter. And lykewise shal you diligently obserue, that the graduation of ỳ Carde shewe the same in their proper altitudes. The cardes that lacke this, ought to be corrected and amended by wise and expert men:

The playne Cardes are imperfecte.

Example of errour in the playne Cardes.

The ignorance of certayne Pilots.

Good Cardes.

The variation of the compasse.

Altitudes.

Sauyng

In the narowe seas they sayle not by elevation of the Pole.

Saying that in the Leuantine sea (called Mare Mediterraneum) and in the Chanell of Flaunders (called the narrowe seas) it is not conuenient for the nauigation, that the Poles be marked in the Cardes by the wyndes, whiche the compasse sheweth, for as muche as they sayle not by the altitudes of the Pole. Lykewyse, it shal not be inconuenient, but rather very necessary (to auoyde so many errours, of the which do flowe great dangers, and suche a confusion) that your Maiestie shoulde commaunde certayne learned Cosmographers, and expert in the arte of sayling, to verifie the altitudes of ỳ Pole, that arc of Ports, Capes, Ilandes, and people by the coastes of the Sea, and in like maner truely to describe the coastes of the lande, especially of the Nauigation of the West Indies, or Mundo Nueuo, where it hath pleased God that so many nations and people haue receyued the water of holy baptisme, commyng to the knowledge of the true God, whereby the Christian empire is greatly amplyfide, besyde the great rychesse had by the sayde Indies. And this hath God miraculously wrought by the conquestes of your Maiestie, in subduyng infidels, and gentiles, to the obedience of the true Catholique fayth. Whereby, not onely God hath been well pleased, but also your Maiestie hath receyued perpetual fame, with eternal renowne, and immoral glory to your posterine in worldes to come.

Correction of the sea Cardes.

The West Indies.

Charles the fyfth.

The iii. Chapter of the vertue and propertie of the Lode stone, called in Latine Magnes, and in Spanishe, Piedraymen.

The Lode stone (as wryteth Cardinall Cusanus) hath substaunce, vertue, and operation. His vertue is engendred of his substaunce, essence, or beyng, and of his essence and vertue proceedeth this operation and effect, in suche sort, that this stone communicating his vertue to iron, by reason thereof, causeth the iron to moue, although betweene the one and the other be a cuppe, or plate of syluer, or a table, or any other lyke thyng.

The vertue, substaunce, and operatiō of the Lode stone.

The attractiue, or drawyng force of the Lode stone, causeth the nature of iron to be and rest in it, and that so fyntely and quietly, that being naturally heauie and ponderous, it descendeth not, because his nature resteth not in hym selfe, but is vnite with the nature of the stone, whiche seemeth to extende it selfe, and as it where to caste foorth actiuely spirite of enchaunting vertue. Insomuche that (as we see by experience) by the sayd vnion, it not onely distributeth his vertue to one iron, but that iron likewyse to another, and that other agayne to another, and so foorth: wherof many rynges or lynkes of iron, be made a chayne.

Vertue attractiue.

Cusan applyeth this to the glorified body of Christe. accordyng to these wordes, If I shalbe exalted, I wyll draw al vnto me.

Saint Augustine (as he wryteth in his bookes, De ciuitate Dei) dyd maruayle that he sawe an iron moue it selfe vpon a vessel, by mouyng the Lode stone vnder the vessel.

It is called Magnes, because the inuentour, or fynder therof, was so named: who (as Plinie wryteth) keepyng catel in East India, had his shoes soled with plates of iron, and iron nayles, suche as they vse in Gascone, and had in his hande a staffe with a pyke, or hooke of iron: and restyng hym selfe vpon a quantitie of this stone, coulde not remoue his feete, neyther lyft vp his staffe. Then staying a whyle astonyshed, as ignorant of the cause, at the length began to perceyue the propertie of the stone, and to vnderstande the attractiue vertue thereof (the colour of it differeth not from iron) and was therefore called quicke iron, or lyuing iron.

Why the Lode stone was called Magnes. & the fyndyng thereof.

The

Sundry kyndes of the lode stone.

The best kynde of these stones, is of Auzurine or blew colour, as the sea sometymes appeareth.

Of these, are found fyue kyndes or differences. The first is, of Ethiope. The seconde, of Macedonie. The thyrde, of Lechio in Boetia. The fourth, of Troada, neare to Alexandria, And the fyfth of Asia: but at this day, it is founde in dyuers other places. It is founde also in many places in Spayne: as in the hyll Morena, neare vnto the village of Calera, beyng of the order of saint James, in the prouince of Leon. Lykewise in a hyll of Moron, in the territorie of the Erle of Vrenia, is great quantitie thereof, and in diuers other places. The stone that we most commonly vse, is of the Ilande of Elua, of the Lord of Pomblina, whiche I iudge to be better then that of Denmarke. This and the other, haue vertue to draw iron vnto them. And true it is that Teanxedes writeth, that in Ethiope is founde an other kynde of this stone, that putteth iron from it. Auerroes the commentator of Aristotle, denyeth that Magnes draweth iron vnto it, but sayth, that iron by his naturall inclination, doth moue to the stone, as to his naturall place, by a certayne qualitie, whiche the stone impresseth in iron. And beside this vertue and propertie that it hath to drawe iron into it, it hath also another: and that is, that it geueth vnto iron vertue and power, to shewe the two poyntes of the Horizon, where it cutteth the Meridian, that is in the two wyndes, of North, and South. These vertues are founde more intent, in onely two partes of the stone: and these are euer oppolite, or contrarye the one to the other, and so are they contrary in operation. For iron touched with the one part, and placed where it may moue freely, will shewe the North: and an other iron touched with the other parte, will shewe the South. Fyndyng this experience, may be knowne, what parte of the stone answereth to the North, whiche the Mariners call the face of the stone, and lykewyse of the South. This stone is so necessary, that without it, Nauigation shoulde be imperfecte and vncertayne, because it geueth lyfe to the needle and compasse, whiche leadeth and guydeth the Pilote, that he maye goe certaynely

The lode stone of Spayne.

The Ilande of Elua.

The lode stone of Denmarke.

The lode stone of Ethiope.

Diuers opinions of the lode stone.

The qualities and properties of the lode stone.

The partes of the lode stone.

What parte of the stone answereth to the North and South.

in

ly in the day, and not erre or wander in the nyght. Also it sheweth and directeth to compasse the worlde, and to knowe the wyndes. And therefore, forasmuch as the compasse is so necessarie, we intende to shewe the order and manner howe it ought to be made, for it may chaunce to fayle, or be lost in the viage.

The vse and making of the Maryneres compasse.

The.iiii. Chapter, of the making of the Mariners compasse for Nauigation.

TAke suche paste or paper, whereof Cardes are made, and make in it a Circle, of the quantitie of a spanne. or litle more or lesse. In the whiche you shall paynte the .31. wyndes. with theyr colours, in suche order as we gaue in the firste and seconde Chapter of the wyndes, and of the Carde, not forgettyng to marke the North with a floure deluce, and the East with a crosse. And more then this, may euery man garnysshe and beautifie the same, as seemeth best to his phantasie. Then on the lower or neather parte of this paste, you must drawe a lyne, whiche shalbe directly vnder that of the North and South, which shalbe the marke for the settyng of the Irons and Steeles. Then shal you take wyre of iron or steele, of the bygnesse of a great pynne, or accordyng to the bygnesse or the roundnesse of the paste, floure, rose or flye, as it may be called. This wyre must be bowed double, so that euery of the partes may be equally as long as the Diameter of the flye, and a quarter part more. The endes or poyntes of these irons or steeles, must be pynched togeather, and made close, and open in the myddest, the one from the other, vntyll the endes come to be equall with the extremities of the Diameter of the flye, and so shall the steeles remayne in maner in fourme of an edgge. These wyres or irons must be made fast in the

The floure deluse, and the crosse.

The flye, floure, or rose of the compasse.

The lyne of the North and South

the neather parte of the flye: so that theyr extremities, endes, or poyntes, come precisely by the lyne of North and South. And to fixe or fasten them so, they must be couered with a thinne paper glued, leauyng the poyntes and endes vncouered: And these endes must be touched with the Lode stone, in this maner. The part that is vnder the flourc delice, must be rubbed on that part of the stone that answereth to the North, as is sayde in the Chapter before. And this shall suffice for the perfection of the compasse. Yet some there be, that for superaboundaunce, doo touche the other part of the Iron, with that part of the stone that answereth to the South, although it may suffice to touche it only with the other parte. This touchyng of the Iron with the stone, that the demonstratiue or woorkyng vertue may shew it selfe foorth, must be done with geuyng certayne strokes with a hammer, on that parte of the stone wherewith the Iron muste be touched, that is to say, in the North part, or the South: And from these wyll come foorth of the stone certayne beardes, lyke smal yficles, wheron you shal rubbe the point of the Iron, as you woulde whet a knyfe: and so shall certayne of thõse beardes of the stone, cleaue and sticke fast to the Iron. And the Irons thus touched, with the beardes cleauyng to them, you must take a pricke or poynt of laton, of Piramidal, sharpe, or steple fourme, which is hode below, & sharde aboue towarde the point, this is made round, or eyght square, as semeth best: and in the neather parte or breadth, it must be bored (but not through) with a borer, which must also be of Piramidall fourme, and center into the myddest of the sayde Piramidall pricke or poynt of laton, vnto the myddest, or somewhat more. This Piramidall poynt (whiche the mariners call the Captell) muste be of heyght halfe a fynger breadth, or accordyng as the compasse shalbe, and muste be put through the center of the flye, so that the poynt come foorth on the hygher parte thereof, and must there be made faste, and wel fyrte. Then shall you take a rounde bore of wood, within the whiche the needle may be, not touchyng the sydes of the same: And this muste be of the heyght of

The touching of the needle with the lode stone.

The breaking of the stone, to drawe out his vertue.

The boxe of the compasse.

the

the halfe Diameter of the compaſſe. And the grounde or bottome thereof muſt be ſet to it, as the couering of a boxe, that it may be eaſely taken of, and put on, to haue often recourſe, to touche the irons with the ſtone (which they call feeding) when neede ſhalbe, that the vertue of the compaſſe fayle not. Alſo in the middeſt of the ground, or flooxe of the boxe, you muſt ſet a ſharpe poynt or pricke, made of a wyre of laton, this muſt ſtande ryght vp, and vpon the pricke or poynt thereof, you ſhall ſet the boxed hole of the Capitel, and that the wynde enter not aboue, you ſhal couer the boxe with a glaſſe. And thus beyng touched with the ſtone and ſet vpon the poynt, it ſhall ſhewe the true part of the North, and conſequently all the other wyndes.

Feedyng the needle with the ſtone.

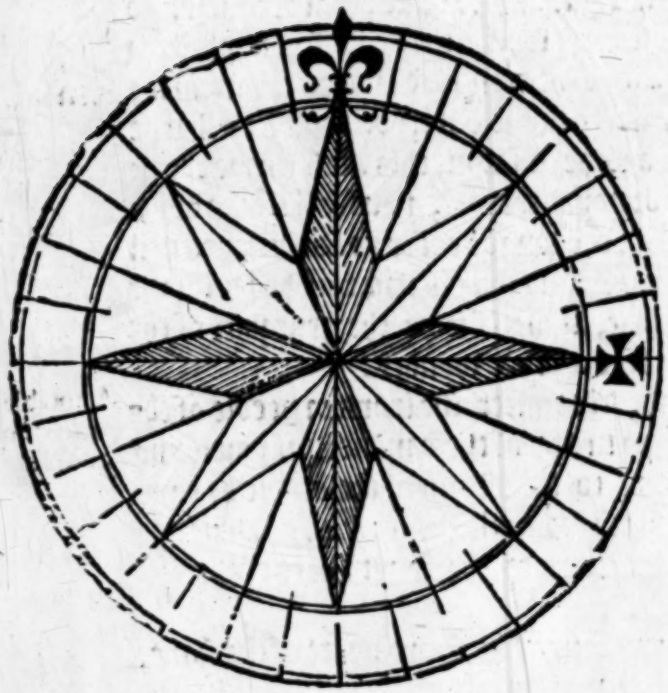
And here is to be noted, that after the irons or needle of the compaſſe hath been touched in any of theſe maners, if you bryng the North part of the ſtone, to the North of the needle or compaſſe: then wyl the North of the needle come to it. And yf you bryng the North part of the ſtone, to the South part of the needle, it wyl flee from it.

A notable experience of the Lode ſtone.

And contrariwiſe, yf you bryng the South part of the ſtone, to the South of the needle, it wyll come it, and yf to the North, it wyll flee from it. This is vnderſtoode, the needle or compaſſe ſtandyng as it ſhoulde be. And this alſo is a good ſigne, to know which is the North part and South part of the ſtone.

Moreouer, this boxe muſt be put within another boxe, in the which it muſt hang vpon two circles of laton, annexed the one within the other: whiche ſerue that the compaſſe ſway not, or hang not toward the one ſyde or the other, although the Shyppe ſway, and this boxe alſo muſt haue his couer of wood, to keepe the other. You ſhall lykewyſe obſerue that the poynt of the Capitell, and the hole thereof, and alſo the poynt or pricke vpon the which it reſteth, by vpryght, and lykewyſe the Roſe, that it declyne not to one part or other. And if it be quicker then it ought to be, then make the poynt that it goeth vpon ſomewhat blunter.

The





The. v. Chapter, of the effect or propertie, that the compasse hath to the Northeasting or Northwesting, whereby is knowen the variation of the compasse.

The variation of the compasse

MANY and dyuers are the opinions that I haue hearde, and also read in certayne wyters of latter dayes, as touchyng the Northeastyng and Northwestyng of the compasse, and yet me seemeth that none dooth touche the pricke, and fewe the whyte. They call it Northeastyng, when the neevle

needle sheweth or poynteth from the North (whiche is his true marke) towarde the Northeast: and Northwesting, when from the North, it declyneth towarde Northwest. For the better vnderstandyng of these differences, whereby the needles differ or vary from the pole, you must (being in the Meridian where the compasses shewe the pole) imagine a poynt vnder the pole of the worlde, and this poynt to be without all the heauens, conteyned vnder the fyrst moueable. The whiche poynt or part of heauen, hath a vertue attractiue, that draweth vnto it Iron touched with the part of the lode stone, correspondent to that certayne part of heauen imagined without or vnder al the heauens, moued by the fyrst moueable. For yf it were imagined to be moued within any of the moued heauens, then the attractiue poynt, by the mouyng of the first moueable, & consequently the compasse, shoulde make the selfe same mouing in. 24. houres, which is neuer seene. And therefore this poynt is not in the moueable heauens, neyther in the pole. For if it were in it, the compasse should not vary, Northeasting, and Northwesting. Therfore the cause of Northeasting or Northwesting, or departyng from the pole of the worlde, is, that being in the sayde Meridian, the attractiue poynt and the pole, are in the selfe same, or in one Meridian: and the compasse shewing the attractiue poynt, sheweth directly the pole. And departing from the same Meridian towarde the East (the worlde being round) the pole of the worlde remayneth to vs on the left hand: and the poynt of the attactiue vertue, shalbe on the right hand, which is towarde the Northeast winde. And in how much more we shall sayle toward the East, the distaunce shall appeare greater vnto vs, vntyll we come vnto the. 90. degrees: and there shalbe the most and greatest Northeasting. And passyng from thence further forwarde, it shal appeare vnto vs, that ỳ attractiue poynt, commeth nearer & nearer vnto the Meridian lyne: and so much shall the compasse goe bettering or amending the Northeasting, vntil it returne to the selfe same Meridian in the opposite or contrary part from whence they came, or where they began, & then shall the attractiue poynt be to them directly vpō, or against the pole of the worlde, & the compasse shal shew ye poynt directly toward it. And agayne, passyng further forward, the pole of the

The poynt attractiue imagined vnder the pole of the worlde.

The cause of the variations of the compas.

Departing of the pole from the poynt attractiue.

The greatest Northeasting.

The greatest northwesting.

The attractiue poynt is vnder the pole.

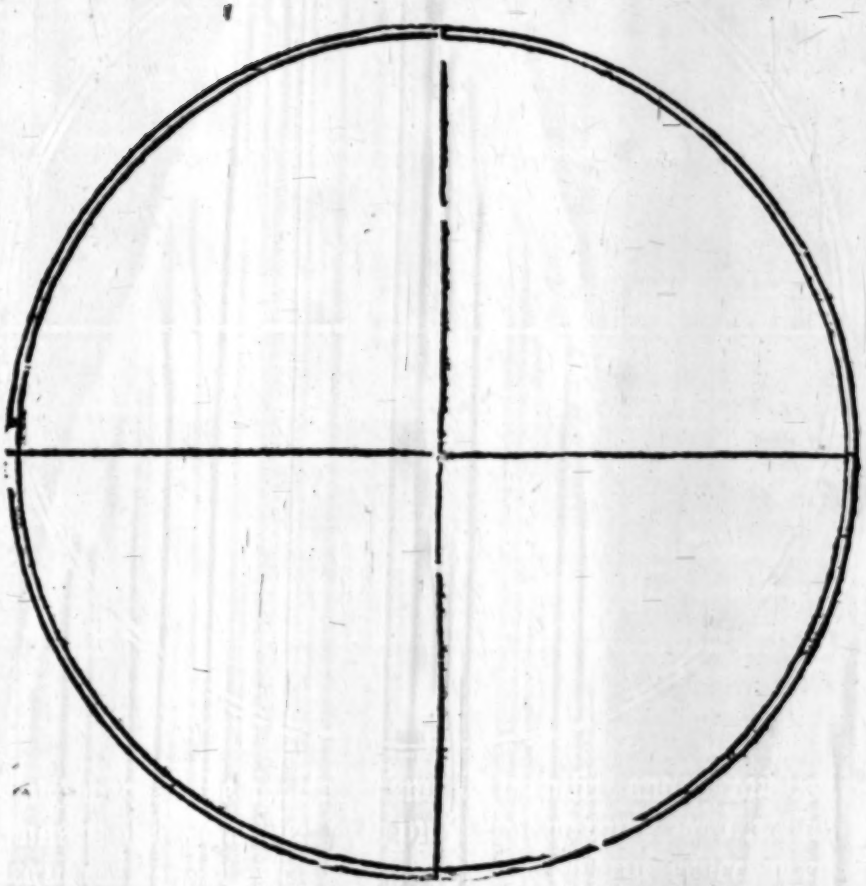
The Northeasting & Northwesting is not vniforme.

The declination of the Sun.

The Meridian that sheweth the pole.

worlde shal remaine to the right hand, and the poynt attractiue to the left hand, and so shall the compasse begin Northwesting, increasing it vntyl it come from thence to the .90. degrees, & there shalbe the most of his Northwesting. For turning towarde the Meridian from the attractiue poynt, it shal go amending or bettering, vntyl it returne to the selfe same Meridian from whence it departed, & there shal the compasse shew the pole of the worlde directly, by, or ouer against the attractiue poynt, which is perpendicularly vnder the pole. And yf from thence they shoulde turne, to passe towarde the West, the pole should rest to the right hand, & the attractiue poynt to the left, & so shall the variation be to the Northwest: and this is the cause of the northeasting, and Northwesting, or variation of the compasse. Also it is not to be vnderstoode that this Northeasting, & Northwesting, is vniforme, as is the departing (or accordyng to the departure) from the Meridian, where the compasse sheweth perfectly: but rather before at the beginnyng of the departing from the sayd Meridian, it maketh difference, or variation in a certaine quantitie, & the increase that is afterward, is litle, and so much the lesse, in how much the more the departing is from the said Meridian. For it is a passion of the circles, deuiding or cuttyng them selues in ỳ sphere: so that these differences are, as are they of the declinations of the Sun: which neare vnto the Equinoctials, are great, & neare to the solstitials, are litle. All the which shal euidently appeare in ỳ figure folowing, which is a circle deuided by two Diameters, into .4. equal partes, cutting them selues in ỳ center in right angles. And from the center poynt (called the pole) cõmeth forth a moueable Meridian: & in it goeth a compasse likewise moueable about the circle. The attractiue poynt is somwhat distant from the pole of the worlde, & from it, commeth forth a threde, which must euer passe by the North & South of the compasse. And the compasse being in the Meridian of ỳ poynt attractiue, that passeth by the pole, shall shew the pole. And without that shal go northeasting, or northwestyng, so varying & departing frõ the true Meridian that commeth forth of the pole of the worlde. It is the opinion of some Mariners, that the Meridian where the compasse sheweth directly the pole, passeth by the Iland of Sancta Maria, and other say, by the Iland of Cueruo in the Asores. De-

Demonſtration of Northeaſting.



☞ And where as the inconuenience is manifeſt and notorious, the ſame muſt be remedied with prudence and tyme, and not to be negligent in the viage: but euer to vſe & obſerue experience, more profitable then the ſubtyle and curious queſtions of the ſecrete ſearchers of natural thinges without experience, whereof reaſon taketh his principall grounde. And therefore the wyſe Pilot ought to knowe by experience (as many of them doo not) how much a good compaſſe doth vary, Northeaſting, or Northweſting from one Port to another. So that to know how much the compaſſe doth vary, Northeaſting, or Northweſtyng, from one place to another (as to ſay, halfe a quarter, or more or leſſe in quantitie as they are diſtant from the ſayd Meridian, where the compaſſes ſhewe the Pole) ſhall in the Nauigation take heede,

Experience, the grounde of reaſon.

Aduertiſement to Pilottes.

and well consyder, in any such vyage, Northeasting or Northwestyng, in the poyntes of the compasse. And this shalbe to sayle truely by the poyntes or lynes that the Carde doth certaynely shewe. As for example. In sayling from any Hauen that is in the sayd Meridian, or from any other part, in seekyng of any port that is to them true Northeast, yf by this way the compasse shoulde Northeast halfe a quarter, then sayling by the poyntes or lynes of the compasse Northeast halfe a quarter to the North, their Nauigation shalbe (excepting other impedimentes) to the Northeast which the Carde sheweth: And by this poynt or lyne, must be made the accompt of such a vyage. And so by the pointes of the Carde, they shall directly fynde the Port that they sought. And by this order shall they gouerne them selues in all Nauigations. For the which, it is conuenient that wyse and expert Pilots, shoulde make notes of obseruations of Northeasting and Northwestyng, that is, from Port, to Port, and to make compilations and geatheringes of suche notes, to cary with them in their Shyppes for regimentes: and not to be busie or curious to amende their compasses, or with the stone to rubbe the Irons or Steeles, neither on the one syde or the other, from whence the Floure deluce doth shewe: For this shoulde cause many inconueniences. Neither ought they to admit in their Cardes, two graduations: especially for that to knowe howe much in euery place the compasse doth goe aside, or vary from the true Meridian, may easely be made an instrument to shewe the same by the Sunne in the day, and by the Starres in the nyght.

Example of sayling.

The variation of the compas.

The. vi. Chapter, of the introduction and principles of the Arte of Nauigation.

FOr as muche as nowe we haue the guyde, whiche is the compasse, it is conuenient to enter into the way, whiche is Nauigation. The whiche (as we haue sayde) is to goe or passe by water from one place to another. And this presupposed, I say that he

he that desyreth to attempt Nauigations, must knowe two thynges, whiche the Carde shal shewe hym. The one is, by what point or lyne he ought to sayle: and this shal the lynes of the saylyng Carde shewe hym. The other is, the leagues of the distaunce: and this shall the scale or trunke of the leagues shewe, takyng with a compasse the distaunce of two places, and applying it to the scale. The knowledge of these two thinges, ought the Pilot to beare in memory: and to put them in effect, ought to direct his foreshyppe to the selfe same wynde, which the compasse doth shewe. For the distaunce, he ought to knowe howe muche the shyppe goeth dayly, wel considering and obseruing the wyndes, tydes, currentes, and all suche thynges as may be with hym, or agaynst hym. And accordyng hereunto, he shall knowe howe muche he hath gone, and what remayneth for hym to goe, and whether he be farre of, or neare vnto the place whither he intendeth to sayle: the whiche in Nauigation, is the ende desired. And because this estimation or computation can not be iust & exact, especially in a long vyage, or in long tyme, it shalbe conuenient that we rectifie or amend it, knowyng the place where the shyp is, on the superficial part of the water, by the place that answereth to it in heauen. This place of heauen, is knowen by the altitude of the pole: and by the altitude of the pole, is knowen the altitude of the Equinoctial: & by the altitude of the Equinoctiall and declination of the Sunne, is knowen the Merdian altitude: and contrarywyse, knowyng the Merdian altitude and declination of the Sunne, is knowen the altitude of the Equinoctiall, and by the Equinoctial, the pole, and by the altitude of the pole, is knowne the latitude: and this is the place that is desyred to be knowen. But for as muche as the heauen is moueable from the East to the West, this place is not knowen as a certayne point, but is knowen as a lyne or paralel at a certayne distaunce from the Equinoctiall, and it is knowen in what poynt of this paralel the Shyppe is, by the altitudes that are taken from beneth: but it is knowen by the lyne that the shyppe hath gone, as we will further declare in the .xiii. Chapter, of making a point or pryke in the Carde. And in this maner you shal haue rectified the way that the shyp hath gone, and consequently the way

In Nauigatiō, what is chiefly to be considered.

The distaunce.

The altitude of the pole and Equinoctial.

The Meridian altitude.

To knowe the place of heauē

To knowe the way of the vyage

that it hath yet to goe.

Rules to know the altitudes.

And forasmuche as these altitudes are so profitable and necessarie, it shalbe needful to geue rules howe we may vse them to our most commoditie. And for this, is presupposed to knowe, that al places situate on the superficiall parte of the earth, and water, eyther they are vnder one Meridian, so that they haue, or where they haue one selfe same longitude, and differ in latitude, or are in one paralel, where they haue one selfe same latitude, and differ in longitude, or are in diuers Meridians and paraleles, where they differ in longitude, and latitude. And I say, that yf thei haue one selfe same longitude, they saile from the one to the other, by the lyne of North, and South, and howe many degrees doth vary the altitude of the pole and of the Equinoctial in heauen, so many degrees haue they gone by sea, or by land; If two places haue one selfe same latitude, they passe from the one to the other by the lyne of East and West. And in suche maner of vyage, the altitudes do not profite vs, because there is no variation. If they differ or vary in longitude, and latitude, they sayle from the one to the other by some of the other lynes. But there are more degrees that corresponde the way that the shyp maketh, then the degrees that vary the altitudes of the Equinoctial, and the pole. And this difference shalbe greater, in how much the lyne shal draw neare to the East and West: And how muche it shal draw neare to North and South, it shalbe lesse. Of the degrees or leagues that aunswere to euery degree of the variation of the altitude, we wyl entreate hereafter in the .xii. Chapter.

Longitude & latitude.

Variation of degrees.

Howe the altitudes are knowen, The fixte Starres. The North Starre.

These altitudes are knowen many wayes, but especially by two: as by the Meridian altitude and declination of the Sunne (as we haue sayde) is knowen the altitude of the Equinoctiall, and by it, the altitude of the Pole. The seconde way, they are knowen by the altitude of some fixt Starre, of those that are not hydde. And among many other, the North Starre is taken, because it is nearest to the Pole. To know the altitudes by the Sun, three thynges are necessarie, that is to say, an instrument, the declination of the Sun, and rules. The instrument to know the Meridian altitude, shalbe the Astrolabie, because it is moste

To knowe the altitudes by the Sunne. The Meridian altitude.

commodious for this purpose, whereof we wyll entreate in the Chapter folowyng. The declination of the Sunne (which is to take it away, or to ioyne it with the Meridian altitude) we haue alredy described in the thirde Chapter of the seconde part. The rule to know when the declinations muste be ioyned with the Meridian altitude, or taken from it, we wyl geue in the .viii. Chapter. To knowe the altitudes of the Pole, by the altitudes of the North starre, two thynges are necessarie: that is, an instrument, and rules. The instrument wherewith the Mariners are accustomed to take the altitudes of the North, they cal Balestilla, which is a crosse staffe, whereof we wil write hereafter in the tenth Chapter. And the rules of the Turne or compasse, which the North star maketh about the Pole, we wyl declare in the .x. Chapter.

The declination of the Sunne.

The altitudes of the Pole.

Iacobes staffe.

The .vii. Chapter, of the making and vse of the Astrolabie, with the which the Mayners take the altitude of the Sunne.

TAke a plate of copper, or latton (whiche for this purpose is better then any other mettal) of the bygnesse that you desyre to make the Astrolabie, and is commonly of the bygnesse of a spanne of the Diameter, & let it be of the thicknesse of halfe a fynger at the leaste: for the mayghtier that it shalbe, so muche shall it be more steadie to make the altitude. This place must be made rounde by a circle, leauyng commyng foorth of the circle or scanner, in the which you shal put a ring or handel with a hole, whereby you may hang the Astrolabie, by a threede or lyne to take the altitude.

After it is thus made, with the ryng or handle annexed thereto make it hyght, and smoothe, publyshed on both the sydes, and all of one equall thickneſſe, that one syde be not heauier then another, which you shal trie in this maner: hang the plate by the ryng or hole that you haue made, and from the same hole hang a plomet of leade, fasted to a heere, or fyne threede of silke. The Astrolabie thus hangyng, free, and at libertie with the plomet, if then the threede fal vpon the center of the Astrolabie, it is wel: but yf the threde doo leane or swarue to the one syde, or to the other, from the center, then is that syde thicker and heauier then the other, and muste therefore be made thynner, vntyl the threede fall iustly vpon the center. This doone, make a circle vpon the sayde center, a litle within the circumference of the Astrolabie. Then draw a Diameter from the center of the hole, in the which the ring or handle is, vnto ỳ center of the Astrolabie, trauersing or ouerthwartyng the whole Circle. And this shalbe called the lyne of the zenith, or Vertical poynt: whiche also shalbe cut with an other Diameter vpon the center, makyng right angles with it. And this Diameter shalbe called the Horizontal line. These two Diameters shal deuide the circle, into foure equall partes. After this, you shall make another circle, so muche more within the second, that betweene the circumferences of both the circles, may be conteyned the numbers of the degrees. Then (the Astrolabie hanging before you) you shall deuide the one part (beyng the superiour and least part) fyrst into three equall partes, and euery part shall conteyne. 30. degrees. Then shall you deuide euery part of these into three other equal partes, and they shall conteyne. 10. degrees: and euery of these deuide into two partes, and they shall conteyne. 5. degrees. This doone, put a ruler vppon the center of the Astrolabie, applying it to euery of the poyntes that deuide the sayde partes, and drawe certayne lynes that passe from the circumference of the first circle, vnto the lesse circumference: and in the spaces of the lesse circle write the numbers of the degrees, beginning in the Horizontal lyne: and in that space put fiue, and in the seconde, ten, and so forth of the other, vntyl the. 90. degrees ende in the lyne of the zenith. Then shall you deuide the spaces that are betweene the fyrst circle and

The rectifiyng of the Astrolabie

The threede and plomet.

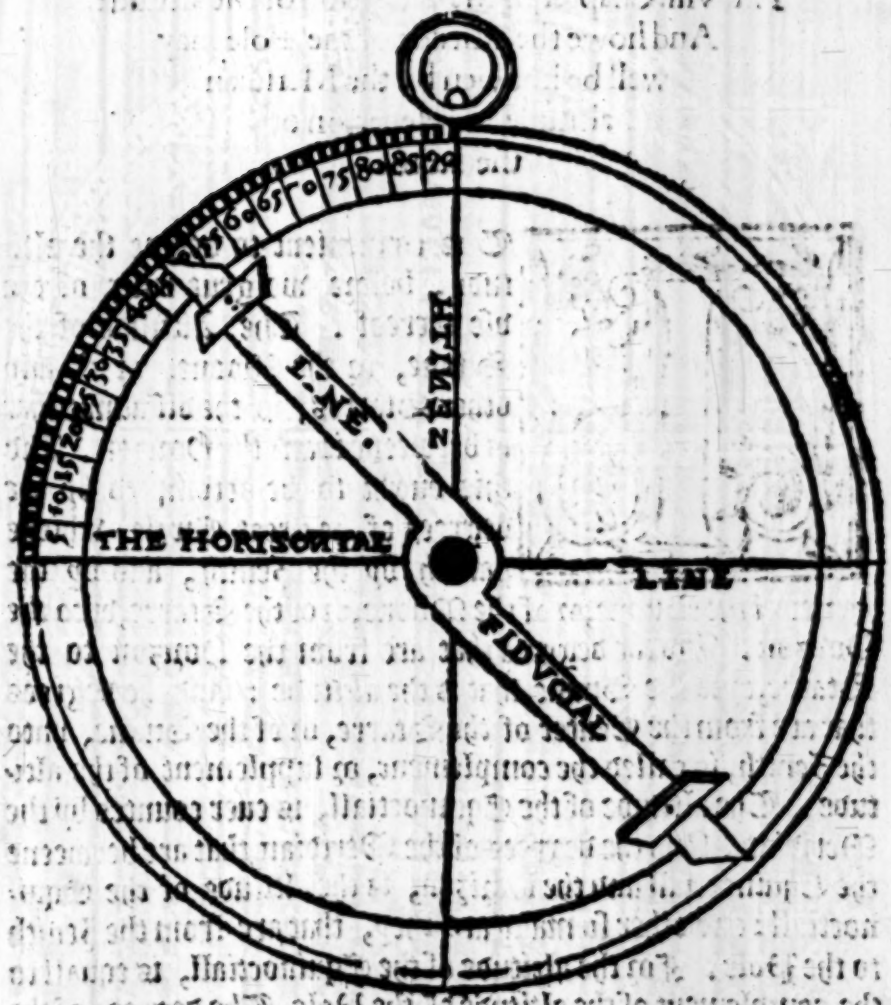
The lynes vertical & horizontal.

and the seconde, euery spare into fyue, whiche shal make the. 90. degrees. The Astrolabie thus made, you shal make the Alhidada or Label. For the whiche, you shall take a plate of latoun, of the breadth of scarcely two fingers, and as thicke as the Astrolabie: also as long as the Diameter of the Astrolabie, and make a lytle in the myddest thereof by the longitude: in the middest of this lyne, make a circle, so great that it may touche in the sides of the place: then cut of this plate on the one syde, that whiche it hath from the lyne to the ryghe hande, and on the other syde, that that it hath frō the lyne to the least hand, leauyng the circle whole. This lyne that shal passe by the center of the circle, is called Linea fiduciæ, (that is) the lyne of confidence, whiche is that, that sheweth in the degrees, the altitude that is taken. Then shall you take away the endes or corners of the Alhidada that are without the lyne, so that you touche not the lyne. This doone, you shal make two litle eyslyng or cayled tables or plates, of the same metal whereof the Astrolabie is made, and of the self same thycknesse that is the Alhidada, or lytle lesse, and of the breadth of the Diameter of the circle of the Alhidada, and let them be a thyrde parte of the ryghe of breadth. In the myddest of these two places, by the heigth, you shal make a lyne. When these are made equal, and al they angles right, in euery lyne of these that you haue made, you shal also make two holes, equally distaunt from the sydes or edges of the sayde plates or tablettes. And of the two holes of euery of these litle plates, the one hole must be as bygge as may conteyne a great pynne: and these shall serue to take the altitude of the Starres. The other must be so subtile and smal as a fyne sowyng needle: and these serue to take the altitude of the Sunne. They must be made in such maner, that the outwarde parte of them be bygger, and lesse within, of the quantitie that I haue sayde. These tablets or erected plates beyng thus made, they must be sothered in the Alhidada, betwene the center and extremities or endes of the same, makyng in it certayne notches where they may be made faste, and sothered: or leauyng fyuste in the plates certayne sharpe poyntes or corners, that may enter into certayne holes made in the Alhidada, wherby they may be made faste vnderneath with pinnes: And they

The Albidada of the Astrolabie.

The holes of the Alhidada.

muste be so set, that the line where the holes of ỹ plates are, may fal upon the lyne of confidence of the Alhidada, so that the one halfe of the plate be set upon the Alhidada, & the other half without it, or at large. In lyke maner you shal take good aduertisement, that the great hole of the one plate, stand directly agaynst the great hole of the other plate, & be nothyng at al awry. This done, you shal bore the Astrolabie though by the center, making a very rounde hole, that may haue in the myddest of it the center of the Astrolabie. This hole shalbe of the biggnesse of a goose quyl. And the like shal you make in the center of the circle of the Alhidada. Then shal you make a pynne or nayle of the same laton, the whiche on the vpper part of the Alhidada may haue a playne and rounde head. This pynne also shalbe very rounde and smoothe, that it may enter iust and close into the hole of the Alhidada and Astrolabie. And at the ende or poynt therof, comming forth on the other side of the Astrolabie, must be a hole made sydeway though the pynne, close to the plate of the Astrolabie, of the byggnesse of a litle naile or pinne, that may be put therein, to make fast together the Alhidada with the Astrolabie, so that the Alhidada may thereby be turned round about ỹ Astrolabie, as appeareth in this figure folowyng.



To take the altitude of the Sunne, hang vp the Astrolabie by the ryng, and set the Alhidade against the Sunne, and rayse it, or put it downe, in the quarter that is graduate, vntyl the beames of the Sunne enter vp by the litle hole of the other tablet or raysed plate, and precisely by the other litle hole of the other tablet. Then loke vp on the lyne of rule place: and how many degrees it shewe th in the quarter that is graduate (begynnyng from the Horizontall lyne) so many degrees of height hath the Sunne. In lyke maner shall you doo to take the altitude of any other. Ster, looking through the great holes, because this may hardly be seene by the litle holes. To take the altitude of the Sunne.

The

The. viii. Chapter, of the definition of the altitude. And howe the altitude of the Pole may well be knowen by the Meridian altitude and elcuation of the Sunne.

IT is conuenient to define the altitude, before we geue rules of the vse thereof. The Altitude of the Sunne, or the Moone, or of any other Starres, is the distaunce that is betweene it and the Horizon. And this ought to be accompted by the degrees of the great Circle, which passeth by the Zenith, and by the center of the Sunne, or of the Moone, or of the Starre, vnto the Horizon. And the degrees that are from the Horizon to the Starre, or to the Sunne, that is the altitude: And the degrees that are from the Center of the Starre, or of the Sunne, vnto the Zenith, is called the complement, or supplement of the altitude. The altitude of the Equinoctiall, is euer counted by the Meridian. And the degrees of the Meridian, that are betweene the Equinoctiall and the Horizon, is the altitude of the Equinoctiall: and other so many are they, that are from the Zenith to the Pole. For the altitude of the Equinoctiall, is equall to the complement of the altitude of the Pole. The degrees of the Meridian that are betweene the Equinoctiall and the Zenith, is called the complement of the altitude of the Equinoctial, and is equall to the altitude of the Pole. And although we haue defined the altitude in generall, yet shall we onely practise our selues by the Meridian altitude of the Sunne. The Meridian altitude, is the greatest altitude that the Sunne hath euery day: and that shall be, when the Center of the Sunne is in the Meridian. And the Arke of the Meridian, that is betweene the Horizon and the Sunne, is the Meridian altitude. So that when we say the altitude of the Sunne is taken, it is vnderstoode at midday. The shadowes that the Sunne then maketh, are in three sortes.

What is the altitude of the planettes or starres.

The complement of the altitude.

From the Zenith to the pole.

The Meridian altitude of the Sunne.

The shadowes that the Sunne maketh at mydday.

For eyther to be it casteth the shadowe towarde the North part, or toward the South, or pendiculer by a right vp lyne, so that at mydday, or noone, nothyng that standeth vpryght, geueth any shadowe at al. But forasmuch as there is such variation in declinations, altitudes, shadowes, and paralelles, it shalbe necessarie to geue rules for all variations. And these shalbe reduced into foure briefe and compendious rules, the whiche I haue here described, that the wyttie may haue profite by them, and the rude learne them: not caryng for the rules of the Mariners, because they are so long and tedious. For (as the Philosopher sayth) it is vaynely done by many, that may well be done by fewe.

Rules for all variations.

When the shadowe shalbe perpendiculer, it is because the Sunne is in the Zenith, and 90. degrees aboue the Horizon. And then how many degrees of declination the Sunne hath, so much shal we be distant from the Equinoctiall, toward the part where the Sunne declineth. And if it haue no declination, it and we shalbe vnder the Equinoctiall.

The perpendiculer shadow.

But when the Sunne and the shadowes shalbe to vs from the Equinoctiall, towarde one of the Poles, we shall take away the declination from the Meridian altitude, and then shall remayne the complement of the elcuation, which complement beyng taken from. 90. degrees, then shall remayne that whiche we be distaunt from the Equinoctiall, towarde the same Pole.

The declyning shadowes.

When the Sunne declineth from the Equinoctiall, towarde the one Pole, and the shadowes shalbe towarde the other, we shall ioyne the declination with the Meridian altitude: and yf all come not to. 90. then substract them from. 90. degrees, and we shall haue the complement, and so muth shall we be distant from the Equinoctial, towarde that Pole to the which the shadowe falleth. And yf they be more in number then. 90. then the ouerplus of. 90. shall we be distaunt from the Equinoctiall, towarde the Pole where the Sunne declineth. And if they be iust. 90. we shalbe vnder the Equinoctiall.

When the Sunne hath no declination, we shalbe distaunt from the Equinoctial the complement of the Meridian altitude, towarde the Pole where the shadowes are. By these rules (beside the vse whereof we haue spoken) may be knowen how much

When the Sunne hath no declination.

13

is the greatest declination of the Sunne, the altitude of the Equinoctial, the day, houre, and minute, when the Equinox was: the which is knowen as foloweth.

To knowe the greatest declination of the Sunne.

Hauing taken the greater Meridian altitude of the Sommer (which is in the beginnyng of Cancer) and the lesse of Winter, (which is in the beginnyng of Capricorne) takyng away the lesse from the more, the rest is that, that is from Troppke to Troppke, & consequently parted by the myddest, is the greatest declination. As for example. I suppose, that beyng in the Citie of Cadiz, to fynde the great Meridian altitude of the Sunne (beyng in the beginnyng of Cancer) to be. 77. degrees, and the lesser Meridian altitude (which is, when the Sunne is in the beginning of Capricorne) to be. 30. degrees: then takyng. 30. from. 77. remayne. 28. degrees: and so much is frō Troppke to Troppke. And the halfe (which is. 23. and a halfe) is the greatest declination.

Example.

Consequently the greatest declination added to the lesse Meridian altitude, takyng it away from the greater Meridian altitude, that ryseth thereof, is the altitude of the Equinoctiall. Example. 23. and a half of the greatest declination, ioyned with. 30. of the least Meridian altitude, or taken away from the. 77. of the greatest Meridian altitude, remayne. 53. degrees and a halfe, which is the altitude of the Equinoctiall, in the Citie of Cadiz. Hereof it foloweth, that when we shal take the meridian altitude in. 53. degrees and a halfe, that day is the true Equinoctial. But yf it had one day lesse, and the other day folowyng it had more, we must take the lesse from the more, & fourme the rule of three vppon the rest, saying, If. 24. minutes (whiche is that that the Sunne declineth in one day) doth yeelde. 24. houres, how much shall those minutes that lacketh of. 53. degrees and a halfe of the altitude of the Equinoctial, yeelde me? Multiplying & deuiding according to the foreseyd rule, then that which commeth thereof, shalbe the houres after the midday, when it is Equinox.

Example.

The true Equinoctial.

Example. Example of the experience that I made in the Citie of Cadiz the tenth day of Marche at midday or hygh noone, I toke the altitude of the Sunne, in. 53. degrees, and. 26. minutes, they lacke to be the Equinoctial. 4. minutes. An other day, the. 11. of Marche,

Marche, at noone, I tooke the Sunne, in. 53. degrees, and fiftie minutes: which are more then the Equinoctiall by twentie minutes. Then to knowe at what houre the Sunne was in the. 53. degrees, and thirtie minutes of the Equinoctiall, I tooke away the Meridian altitude that I tooke at the tenth of March, from that that I tooke at the eleuenth, which is the difference. 24. minutes, and I formed the rule, saying: if. 24. minutes the Sunne dyd ryse to me, in. 24. houres, then in how much tyme shall ryse vnto me the foure minutes that failed me at the tenth of March: I multiplyed, deuided, & found, that in foure houres: and so shal you say, that the Equinoctiall was in the citie of Cadiz the tenth day of March, at foure of the clocke at after noone, which is vnderstoode (according to the Astronomers) at foure houres run at the eleuenth day of March, at this present yeere. 1545.

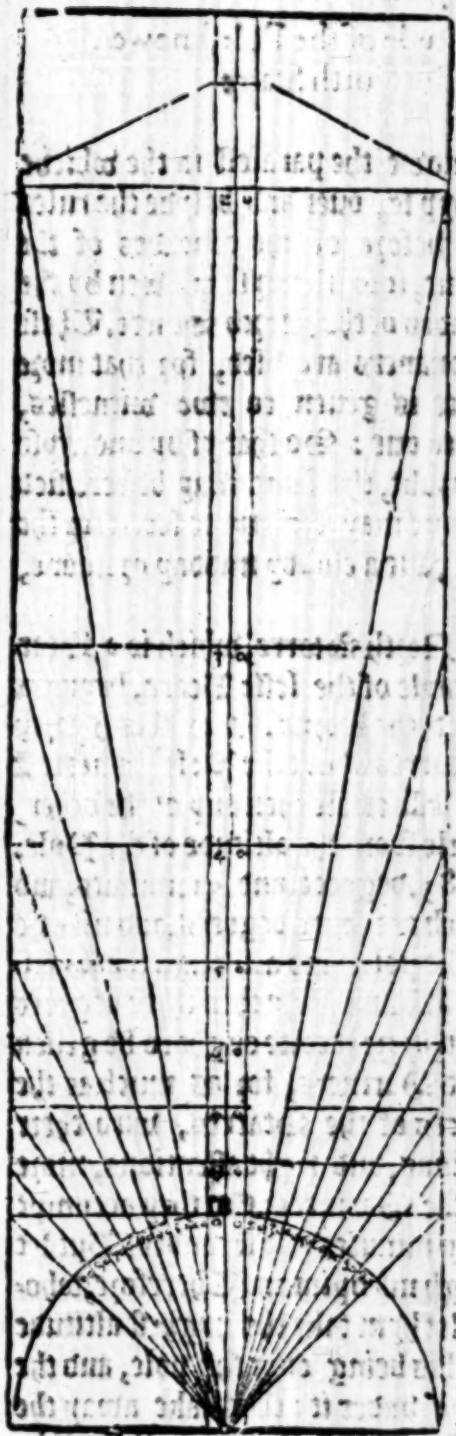
The. ix. Chapter, of the making of the crosse staffe, wherewith the Mariners take the altitude of the North Starre.



Make a square staffe or yarde, of the thicknesse of a fynger, more or lesse, according to the goodnesse of the wood, and of length syxe spannes, or more. For the longer that it is, the more precyse shall it be, and the degrees shalbe the greater, whereby foloweth the certaynetie of the altitude. Then take a very playne table, of the length of the staffe, and two spannes of breadth, or at the least a spanne and a halfe: and in the myddest of this Table, make a ryght lyne by longitude, and in the one ende of this lyne, make another lyne that may cut it in ryght angles. And vppon the cuttyng of these two lynes, put the foote of the compasse, and make halfe a circle, whiche may remayne on the parte of the long lyne, so that the halfe circle may haue so much Diameter, as you desire the heighte

heyght of the hammer, head, or crossepeece of the staffe to be. This halfe circle being made, you shall drawe two lynes, equidistaunt to the lyne whiche you haue made by the myddest of the Table. These lines must touch in the extremities or endes of the halfe circle. Then deuide euery halfe of ỳ halfe circle, or quarter of the circle, into two equal partes, & the two halfes that shal en. in the first line, deuide eche of them into. 90. equall partes. Then take a ruler, and put the edge thereof vpon the center of the halfe circle, and vpon euery of the markes which deuide the. 90. parts, and so proceede, makyng punctes in the lynes, whiche you haue made equidistaunt to the fyrst lyne. Then drawe certayne ryght lynes, from the punctes of the one lyne, to the oppolite punctes of the other: and so shal the draught be ended. Then take ỳ staffe or yard, & put the one end thereof in the center of the halfe circle, and apply the edge of the yarde to the lyne that goeth by the myddest of the Table: and marke in the yarde the markes that are in the sayde lyne, by meanes of the trauersyng lynes, and see also that the markes which you make in the yarde, be trauersing lynes, and make them their numbers, beginning at the ende or poynt of the yarde that shalbe to the contrary part, from that which you did in the punct of the halfe circle. And to knowe with what degrees you shall beginne the yarde or staffe, and what number you shal marke in the fyrst lyne of the punct, looke how many degrees are from the circle whiche you deuided betweene the lyne that goeth to the last marke, and with so many degrees enter, and so consequently shall you place the numbers from fyue to fyue, or from tenne to tenne. When you haue thus numbred the yarde, then to make the crosse peece thereof, take a table or planke of good wood, which shalbe so muche in length, as shalbe the Diameter of the halfe circle, & so much in breadth as three tymes the thycknesse of the yarde, and of thycknesse two fyngers, or lytle lesse. On the one syde also it must be very playne, and on the other syde in the myddest it must haue a square or quadrature of al the thicknesse of the plancke, and from the square to the endes, it must be made thinner and thinner, so that it hath in maner the fourme of suche pickars wherewith

myllenes



milstones are pycked. And in the myddest (by longitude and latitude) it must haue a square hole, by the whiche the parde may enter iust, and make right angles with the crosse peece. And the poynt of the parde must enter by the playne syde of the crosse peece, and come fooyth of the square syde thereof. To take the altitude of the Nozth Starre, oz any other Starre on the Sea (foz it serueht not on the Lande, noz foz the Sunne, except the Sunne shalbe vnder any thinne cloude, & the Horizon cleare) you shall put the head of the staffe to the corner of your eye, rayssing it vp, oz puttyng it downe, vntyll the neather part of the crosse peece come with the Horizon: and being so, if the higher part of the crosse peece shall come with the starre, you must looke the playne syde of the crosse peece in what number of degrees of the staffe it fall.th, and those degrees shall be the altitude of the Starre: as yf the crosse peece reache not to the Starre, you must hyng the crosse peece nearer to your eye, vntyl the one part therof come with the Horizon, and the other with the Starre, and the degrees, which it sheweth, shalbe the altitude.

To take the altitude of the starres.

The.x. Chapter, of the altitude of the Pole, knowen by the altitude of the North Starre.

TO knowe the paralell in the whiche the hyp is, ouer and beſyde the rules there before of the altitudes of the Sunne, it is likewyſe knowen by the altitudes of the North Starre. Theſe two maners are vſed, for that more credite is geuen to two witneſſes, then to one: So that yf by one aryſe any doubt, the ſame may be certified by the other, and alſo becauſe tyme may ſometyme ſerue for the one, and not for the other: as, to haue a cloudy midday or noone, and a cleare nyght.

The North Starre. The leſſe Beare.

The altitude is taken of the North Starre, which is a Star in the extremitie or ende of the tayle of the leſſe Beare, beyng a conſtellation, commonly called the Horne. For this North Starre (of the moſt notable Starres about the Pole) is neareſt vnto it, and ſhal therfore ſhew a leſſe circle then any of the other, and ſo ſhall his altitude differ litle from the altitude of the Pole.

The Horne. The diſtaunce of the North ſtarre from the Pole.

This Starre hath declination. 85. degrees, and. 51. minuts, and the complement to nientie (which are foure degrees, and nientie minutes) is his diſtaunce from the pole. And although the Mariners hold opinion, that it is not diſtaunt more then three degrees and a halfe, yet to my iudgement, more credite ought to be geuen to the Aſtronomers, then to the Mariners, for as much as the Aſtronomers do knowe the places of the Starres, with their longitudes, latitudes, declinations, and right aſcentions, more perfectly and preciſely then do the Mariners: For they accompt not onely by degrees, but alſo by minutes and ſecondes. But let none deceiue them ſelues thyough my opinion. Therefore, whoſoeuer wyll preciſely know it, let hym take the hyghest altitude of the North Starre, which is his being ouer the pole, and the leſſe altitude, which is his being vnder it: then take away the leſſe from the more, and the halfe of that that remayneth, ſhall be the diſtaunce of that Starre from the pole of the worlde.

And

And likewyse by this experience, may be knowen the altitude of the pole, and what all the other starres, that goe not downe vnder the Horizon, be distaunt from it. Joyning the greater altitude with the lesse, and that shall amount thereof, deuyded by the halfe, shalbe the altitude of the Pole: and takyng away this altitude of the Pole, from the greater altitude of the Starre, or the lesse from the altitude of the Pole, the rest that remaineth, shalbe the distaunce of the Starre from the Pole. And as the Pole is inuisible, it can not be seene or knowen, when the North Starre is hygher or lower, except it be by the meane of some other marke: and for this is consydered the position of the former Guards, or watch, being one of the two starres called the Guard, which are in the mouth of the Horne. The Mariners haue noted eyght positions from the former Guarde starre, to the North starre, which answeare to the eyght principall windes. And as the Guarde is to the North starre accordyng to the placyng of these positions, so shall it be hygher or lower from the Pole. Let vs here put the common rules which the Mariners vse, to comply with those that are of opinion of the three degrees & a halfe. And for the opinion of the Astronomers (which is the distance of 4. degrees, and. 9. minuts) I wyll hereafter geue a circuler figure with a moueable horne: then the eyght wyndes of the eyght positions beyng marked, and putyng the Guarde and the North starre in euery of the wyndes, it shalbe the distaunce that the North starre is hygher or lower from the Pole.

The Pole is inuisible.

The two starres called the Guardes of the North starre.

Common rules of the Mariners differyng from the Astronomers.

Common Rules.

The former Guarde beyng in the East, the North Starre is in one degree and a halfe vnder the Pole.

The Guarde being in the Northeast, the North Starre is three degrees and a halfe vnder the Pole.

The Guarde being in the North, the Starre is three degrees vnder the Pole.

The Guarde in the Northwest, the Starre is halfe a degree vnder the Pole.

The Guarde in the West, the Starre is one degree and a halfe aboue the Pole.

These rules after the mariners accompt do holde, but not after the Astronomers accompt, as may appeare in the rules next before.

The Guarde in the Southwest, the Starre is three degrees and a halfe aboue the Pole.

The Guarde in the South, the Starre is three degrees aboue the Pole.

The Guarde in the Southeast, the sayde North Starre is halfe a degree aboue the Pole.

The eyght principall wyndes accordyng to foure lynes.

Note that these eyght wyndes, are made accordyng to foure lynes. Whereof two are ryght, whiche are North & South, and East & West: and the other two are crooked, which are Northeast Southwest, and Southeast Northwest. When the Guarde and the North Starre shalbe in the ryght lyne, it shall appeare cleare how they are: and when they shalbe in the crooked lynes, it may be seene, because the Guardes are the one by the other in a ryght lyne.

An instrument to know the rysing or fallyng of the North starre from the pole of the worlde.

To see by Theorike or Speculation, how the North starre ryseth vp, and goeth downe from the Pole of the worlde, I wyll here describe the sayde circuler figure or instrument, which is a cirrle, in whose circumference are wryten the eyght wyndes. The North in the highest place of the instrumẽt, which they cal the head, and the South in the vtacher part thereof, whiche they call the foote: the East in the ryght arme, the West in the left arme, the foure rest betweene these in their places. And here is to be noted, that the lines which passe not through the center, are of the wyndes of their equidistantes that passe through ỹ center. Within this circle, is an other litle cirrle, which describeth the starre of the North, by the mouyng of the fyrst moueable, & hath for his center the Pole of the worlde, as hath the fyrst. This litle circle hath for his Diameter eyght degrees and eyghtene minutes: as foure degrees and nine minutes aboue the pole, and the other foure degrees and nine minutes vnder it. And they are deuided by certaine lynes equidistant to the East and West. In the center of this circle, is annexed a horne, with his seuen starres, moueable rounde about by all the wyndes. And seeyng them in heauen, how, & in what wynde they are, euen so in this figure shal we see the North starre, in what part it is of the degrees hygh or lowe from the pole: & that the Pilot or Mariners shal not erre, I say that he ought not to put the foreguarde in the wyndes that

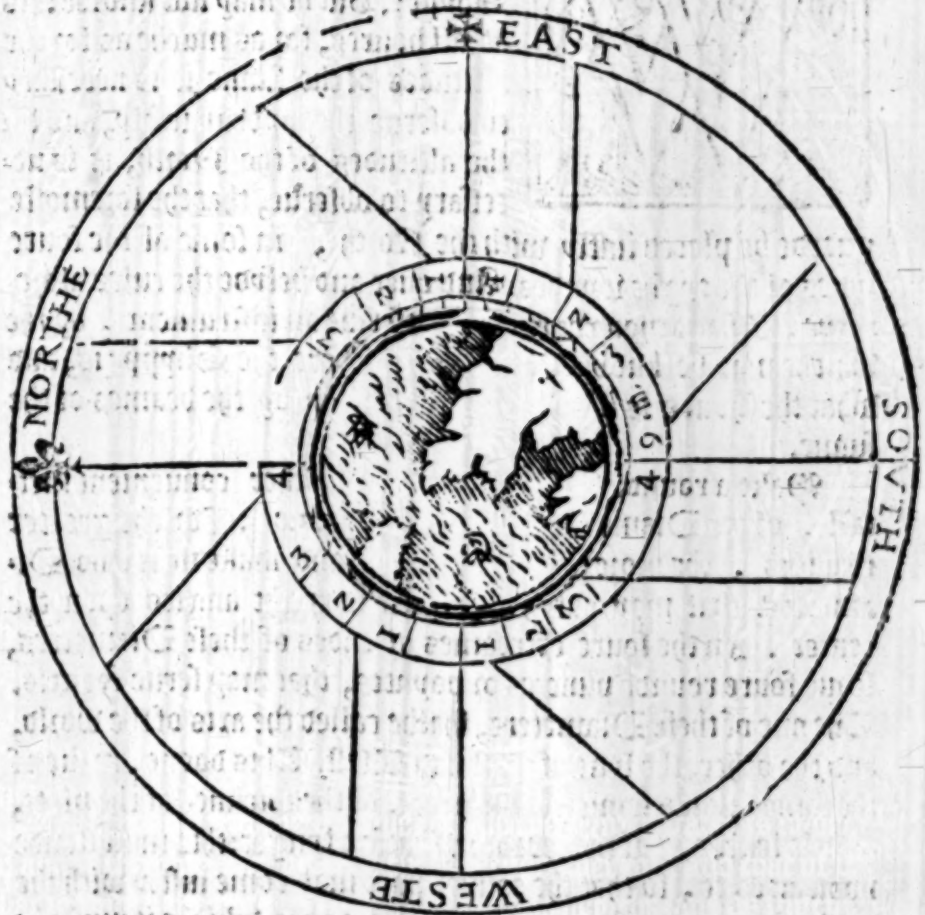
The horne of the seuen Starres.

A aduertisement to Mariners in vsyng the figure folowyng.

passe

passe through the center of the figure, for it shalbe North and South with the pole, and not with the starre of the North, as it ought to be, and so of the other wyndes. And in this maner the starre of the North, shal shewe in the lynes equidistant from the lesse circle, the degrees & partes of degrees that it is hygher or lower then the pole of the world: for the same course, differences, and variations, it maketh in heauen.

This figure is after the .v. stronomers, which affirme that the North starre is foure degrees and nine minutes from the pole.



Thus beyng knowen howe muche the North starre is vnder or aboue the pole, let vs take the altitude thereof: and that of it that is vnder the pole, let vs ioyne to his heyght, and as muche of it as is aboue, let vs take away, and that shal ryse thereof, shall be the altitude of the pole aboue our Horizon. The altitude of the pole aboue Horizon.

The .xi. Chapter, of the compoſition and vſe of an inſtrument, by the whiche without obſeruing the South Sunne, or mydday, is knowen the altitude of the pole, and the houre that is.



I haue geuen rules, whereby the Pilotte may knowe in what paralel he fyndeth hym ſelfe with his Shyppe. But he may not knowe this at all houres, for as muche as for the altitudes of the ſunne it is neceſſary to obſerue the mydday iuſtly, and for the altitudes of the North, it is neceſſary to obſerue, that the foremoſte guarde be placed iuſtly with the North, in ſome of the foure lynes of the eyght wyndes. And ouer and beſyde the rules aforeſayde, I haue thought good to deſcribe an inſtrument, by the whiche may be knowen the paralel where the Shyppe is, and what the houre is at any tyme of the day by the beames of the ſunne.

An inſtrument to knowe the paralel and houre by the ſunne.

Make a rounde plate of Laton, or other conuenient mettall, of the Diameter of a ſpanne, or more: For the greater that it is, the more preciſe ſhal it be: and make in it two Diameters, that may cut them ſelues in ryght angles vpon the center. In the foure extreames or endes of theſe Diameters, leaue foure rounde punctes or poyntes, that may ſerue for axis. The one of theſe Diameters, ſhalbe called the axis of the world, and the other, the lyne of Eaſt and Weſt. This doone, make of the ſame laton a ſemicircular peece, of the thicknes of the plate, or litle leſſe, and of the breadth of halfe a fynger: this muſt ſtande vpon an edge, ſo that the couuex part may come iuſtly with the halfe of the circumference of the plate, to the whiche it muſte be nayled or ſoldered in the neather part of the plate, the ſemicircle beyng rayſed, & that the endes thereof may come with the endes of the axis of the world. And this ſemicircle ſhal you deuide into two equal partes, and euery halfe into .90. degrees, begynnyng from

from the halfe poynt towarde the ende of the Axis of the worlde, whiche are the Poles.

In lyke maner shal you make two circuler peeces, of the bignesse of a peece of foure ryals of plate, whiche they cal rundels, for the houres: these must be made fast in the plate by the Poles of the worlde, whiche may holde or beare them by their centers. And euery of these rundelles must be deuided into .24. equall partes, and although not al, yet the vppermost part of the plate. And aboue in the highest point of these diuisions, you must write 12. because that there it shal shew the myddy or noone. And frō thence, the afternoone houres must begyn their numbers toward the West part, and shal ende .6. houres in the halfe or myddest of the ioynt of the circle with the plate. In the other ioynt of the other part, shal begyn .6 of the houres before noone, & shal ende 12. in the hyghest poynt. You must also make another Semicircular peece, of the breadth of a finger, this muste be playne or flat, and the concauitie or holownesse thereof, equal to the Semicircle of the edge or syde of the plate, and in the endes muste haue two holes, wherein may iustly enter the poynctes that come fourth of the circle, for the houres, whiche are the Poles of the worlde. Also, this Semicircle must haue two lynes, one on the vppermost part, and the other on the neathermost, whiche may deuide the breadth into two equal partes. This halfe circle likewyse must be deuided into two equal partes by longitude, with a trauersed lyne, which shalbe called the Equinoctial, & from this lyne, to the inwarde part thereof, must be counted .13. degrees and a halfe towarde the one part, and as muche towarde the other parte of the .90. that euery halfe of the circle conteyneth. And at euery part where ende the .23. degrees & a halfe, make a trauersed lyne, so that from the one to the other, may be .47. degrees. And in this space shal you drawe certayne lynes equidistaunte with them of the myddest, that they and the myddle lyne, may deuide into .4. equal partes the breadth of the halfe circle. Then looke in the table of the declinations of the sunne, what declination haue the .5. degrees of Aries, and that shal you accompt from the Equinoctiall towarde the one part, and

as muche more towarde the other, makyng a lyne that may trauerse that of the myddest, where that declination dooth ende and touch in the other two lynes. And the same shal you doo at. 10. 15. 20. 25. and. 30. which is the ende of Aryes, and begynnyng of Taurus: & then the lyne shal trauerse al the breadth. The like allo shal you doo to Taurus and Gemini, then in the spaces, wryte the caractes of the. xii. signes, begynnyng Aries from the Equinoctial, towarde the North Pole. And then doo Taurus and Gemini ende in the greatest declination, beginnyng Cancer in the other part of it. Then Leo and Virgo do ende in the Equinoctial, where shal begyn Libra, Scorpio, Sagittarius: and in the other parte, Capricornus, Aquarius, and Pisces, shall ende in the Equinoctiall where Aries began. This halfe circle must haue an openyng, or open place, euen and iuste in the myddest from the Equinoctial, vnto somewhat more then the greatest declinations, and must be a litle broder on the inner parte, then without: and not so brode as may come to the two lynes, because it woulde then take away the graduation of the signes. And in this open place must be put a square grayne or stubbe, whiche on the inner part may come playne with the halfe circle, & on the vtter part may come forth a litle, where shalbe nayled a square peece of Laten, of the breadth of the halfe circle. This graine or stubbe being so nayled with the peece, must haue in the middest a hole, so smal, as may receyue a litle pynne, and by the center of this hole, must passe a lyne, whiche shal trauerse all the grayne. And this lyne shal serue to put the sunne (whiche the hole representeth) in the degree of the signe where it is. This halfe circle where it goeth in the circumferences of the rundels for the houres, must be fyled on the one syde vnto the line that is in the myddest, to make it, and shewe the number of it. For this placyng or settyng of this instrument, you must haue a grosse ryng of laton, as thycke as the plate, and of the breadth of a fynger, or lytle lesse: and so large, that of it may be made a circle somewhat bygger then the plate, so that the plate and the Meridian may easily be conteyned within it. This circle shalbe called the Horizon, which must be deuided into foure quarters.

In lyke maner must be made two semicirculer peeces, & the

The caracts of the. xii. signes.

The hole that representeth the Sunne.

The placyng or settyng of the instrument.

endes

endes of them muſt be nayled or ſothered in the poyntes that deuide the quarters of the circle: and deuide the one from thother in two equal partes, making right ſpherical angles. And in this ioynt of theſe two peeces, muſt be nayled or ſothered a Maſtel, the whiche at the one ende is deuided into two hyaunches or forkes. Then ſhal you make a baſe or foote for the ſame, whiche in the vppermoſt part thereof ſhal haue a concauitie or holowneſſe, where may be ſet a ſaylyng compaſſe or a needle, touched with the Lode ſtone, and couered ouer with a glaſſe. And on the higheſt edges of this baſe, the two hyaunches of the Maſtel ſhalbe made faſt, and this baſe, with the Maſtel, the halfe circle, and the circle, ſhalbe all one peece, whiche ſhalbe called the ſeate or frame of the inſtrument. The Horizontal circle in the endes of one halfe circle, muſt haue two holes, in the which may enter the Axis that are made in the endes of the lyne of Eaſt and Weſt.

The Foote or Baſe of the inſtrument.

Alſo you muſt take good heede when you ſother or make faſt the Maſtel in the baſe, that the North and South of the plate or Horizon, come with the North and South of the needle that is beneath, hauyng euer reſpect howe muche the needle doth vary from the Meridian, by Northeaſtyng or Northweſtyng. In the ioynt of the two halfe circles vpon the Maſtel, muſte be a poynt (called the index or ſhewer) which ſhal ſhewe in the halfe circle, ſothered in the place on the neather part, ỳ degrees that the pole is rayſed aboue the Horizon.

The Index or ſhewer.

For the perfection of this inſtrument, it ſhalbe conuenient to ſet the Horizon very playne and equal at the tyme of the operation or practiſing with the inſtrument, and this may be done in two maners. Whereof the one is, hangyng by a fine threede, at the center of the plate, a plomet made ſomewhat poynted at the neather ende: ſo that the Horizon ſtandyng playne & leuel, the poynt of the plomet may fal vpon the poynt of the inder, and this maner is good for the lande. But for the Sea, you ſhall ſother the Horizon two Axes, litle ſtubbes or endes commyng forth. Theſe ſhalbe put in the two oppoſite holes of a circle of mettal made ſomewhat ſtrong, and this circle muſt haue other two ſtubbes lykewyſe commyng forth, and equally diſtant from the two holes. Theſe muſte be ſothered or nayled in two holes

The placyng of the Horizon.

For the lande.

For the Sea

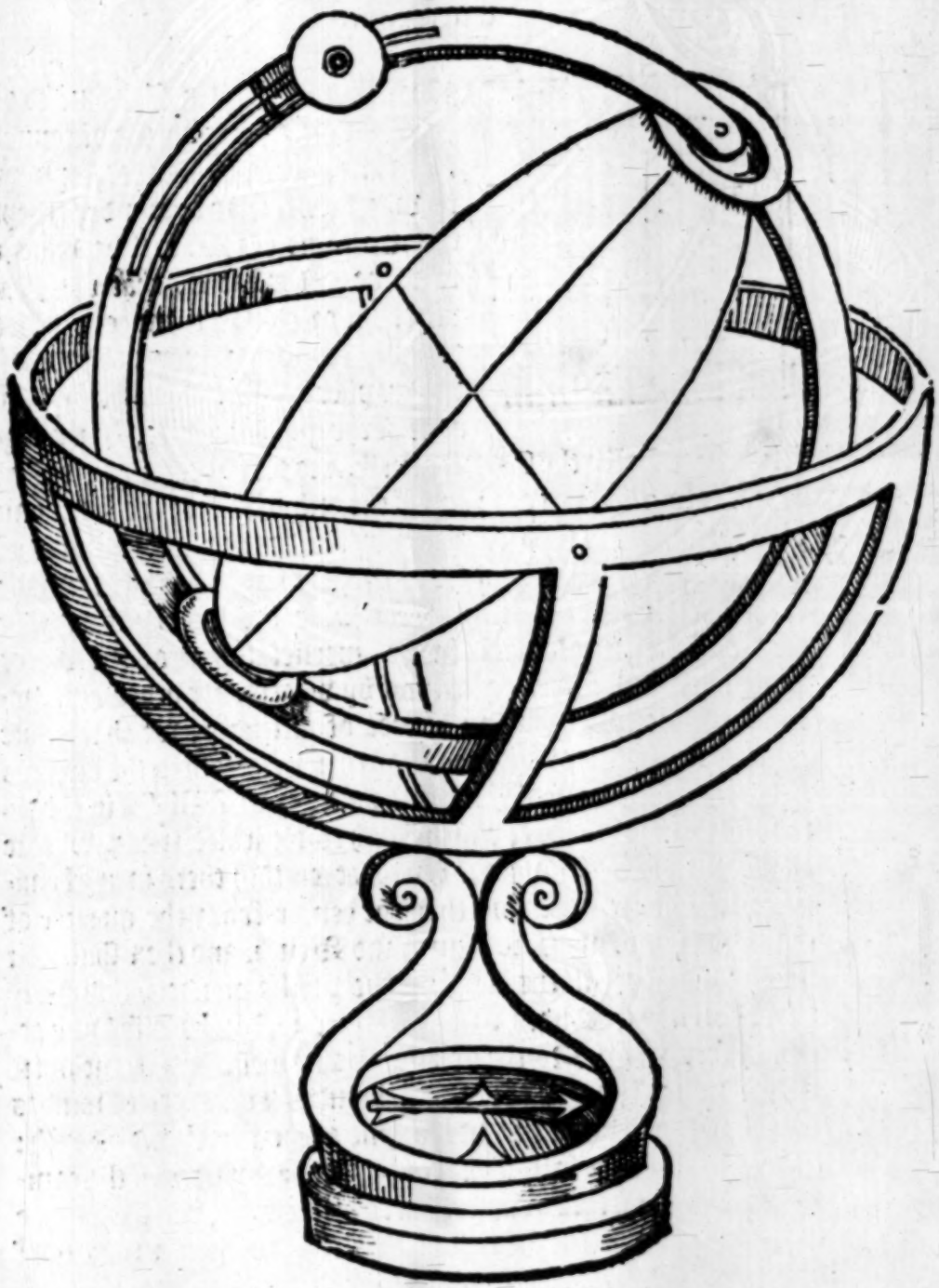
holes of another circle in lyke maner, and the other circle with other two stubbes, inclosed in a boxe. If then the boxe stand euen and leuel, the poyse or wayght shall cause the Horizon to stande leuel, although the shyp sway or roule from side to side. The vse of this instrument is in this maner.

The vse of the instrument.

When you desyre to knowe the paralel in whiche you are, and the houre that is, put the lyne that trauerseth the grayne, in the degree of the signe in the whiche the Sun is (which you shal knowe by the table of the place of the Sunne, in the seconde Chapter of the seconde parte) and set the Nozth and the South of the plate, with the Nozth and South of the needle. Then turne the moueable Meridian agaynst the Sunne, the foote of the instrument standyng fast, and rayse it, or put it downe in the plate, vntyll the beame of the Sunne enter in at the hole of the grayne, and fal in the center of the plate, and standing so, behold the inder, and how many degrees it sheweth from the Meridian, so muche is the altitude of the pole. Then looke where the moueable Meridian sheweth in the rundel of the houres, and there shal you see the houre that is.

The altitude of the pole.

Here foloweth the demonſtration



The. xii. Chapter, of the leagues that are runne for a degree, according vnto diuers courses.

To know the distannce from one paralel to another.

IN the lyxth Chapter, I promised to geue a rule to knowe the distaunce from one paralel to another, saylyng by whatsoeuer lyne or wynde, except the East and West: for the whiche is to be vnderstoode, that the Nauigation or course from one place to another) accordyng to the Cosmographers) ought to be by the arke of the greater circle, for that by this maner shalbe the shortest course, and this greater circle they deuide into. 360. degrees: and al the distances that are from one place to another, they accompt by the degrees and minutes of this circle: and so saylyng from North to South, to one degree of the variation of the height of the Pole, shal answeare another degree of the greater circle in the superficiall part of the water and lande. And therefore saylyng by whatsoeuer other lyne, vntyll the Pole doth vary one degree of altitudes, we shall haue gone more then one degree of the greater circle: and the degrees that aunsweare to euery lyne or wynde, you shall see in the demonstration folowyng, whiche hath two paralel lynes, whiche are East and West, and the lyne that cutteth them in ryght angles, whiche commeth forth of the center from the quarter of the circle that is made, is North and South, and then shall you see by this order, all the other wyndes, halfe wyndes, and quarters of wyndes, reduced to one quarter: For the selfe same accompt serueth for Northeast and Southwest, and Northwest and Southeast, and so of the halfe wyndes & quarters of windes that are equally distant from the lyne of the North and South: and so this quarter shall serue for all the. 32. wyndes of the compasse. Without this quarter, harde by the lyne, you shall fynde two numbers, whereof the first shalbe of the degrees, & minuts of degrees of the great circle, whych is frō one paralel to another.

The arke of the greater circle.

The altitude of the pole varyin. one degree.

The quarter seruing for the 32. windes of the compasse.

The

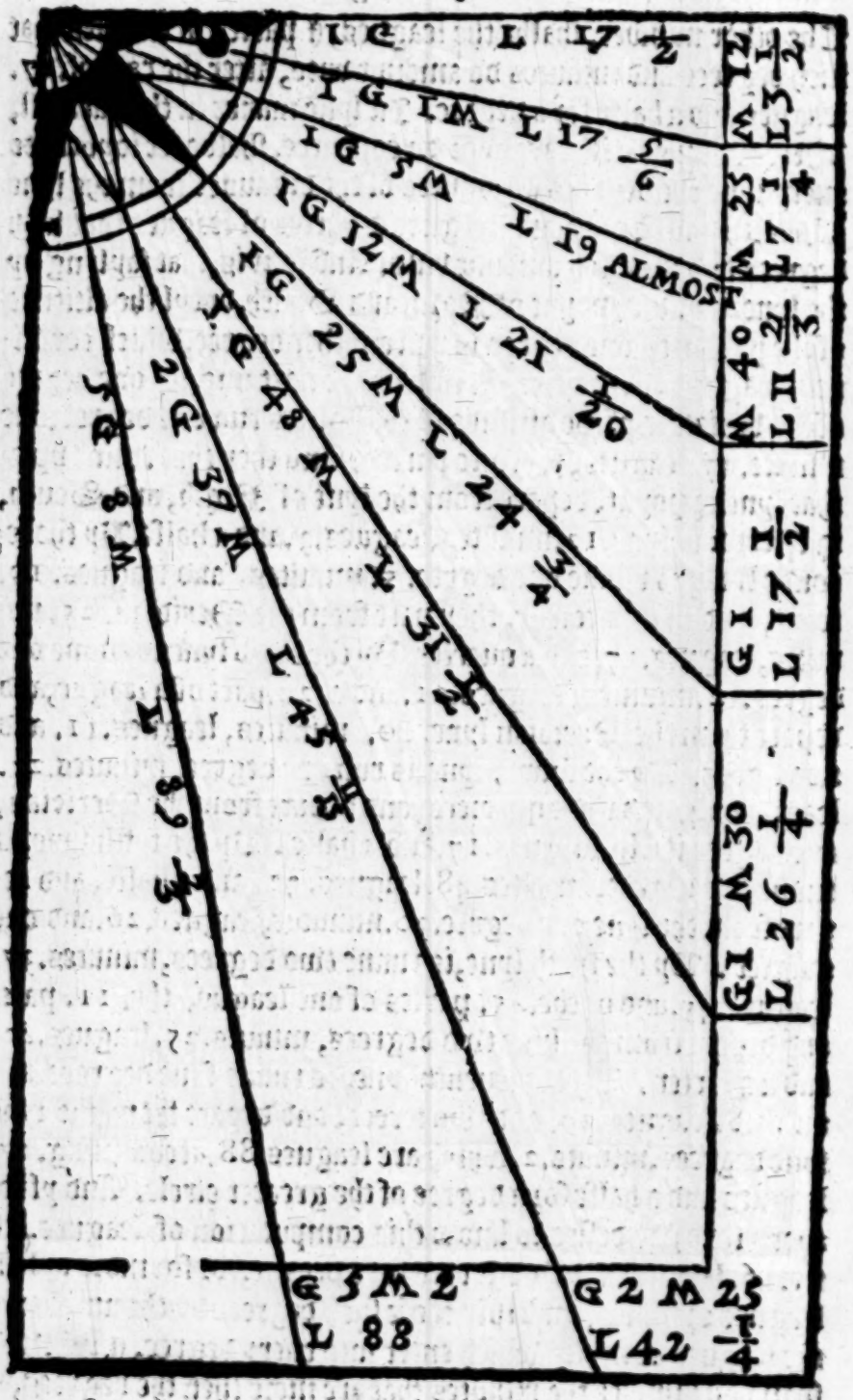
The other number, shalbe the leagues, & partes of leagues, that such degrees and minutes do amount vnto, after the rate of 17. leagues and a halfe for a degree. In lyke maner in the parall, where the lynes of the wyndes do concurre, shalbe set ioyncte to euery lyne the degrees & minutes of the distaunce from the lyne of North and South, and leagues & partes of leagues that such degrees and minutes amount vnto. And so it is, that sayling by the lyne, wynd, or poynt of North and South, onely the altitude of the pole vary one degree, is run another degree, which conteineth leagues 17. and a halfe. And by the next line, for one degree of the variacion of the altitude of the pole, is run one degree, one minute. 17. leagues, & .5. lyke partes. And they that runne vpon that lyne or poynt, depart from the lyne of North, and South, or Meridian lyne. 12. minutes, leagues. 3. and a halfe. By the seconde lyne, is runne one degree. 5. minutes, and leagues. 19. scant, and in this course, they part from the Meridian. 25. minutes, leagues. 17. and a quarter. By the thyrd lyne is runne one degree. 12. minutes, leagues. 21. and a. 20. part of a leagues, and depart from the Meridian lyne. 40. minutes, leagues. 11. and two terces. By the fourth lyne, is run one degree, minutes. 25. leagues. 24. and three quarters, and depart from the Meridian, one degree iustly, leagues. 17. and a halfe. By the fyfth lyne, is runne one degree, minutes. 48. leagues. 31. and a halfe, and depart from the lyne one degree. 30. minutes, leagues. 26. and one quarter. By the syxth lyne, is runne two degrees, minutes. 37. leagues. 45. and of the. 45. partes of one leagues, the. 11. part, and depart from the lyne two degrees, minutes. 25. leagues. 42. and a quarter. By the seuenth lyne, is runne fyue degrees, minutes. 8. leagues. 29. and two terces, and depart from the lyne fyue degrees, minuts. 2. which are leagues. 88. accompting. 17. leagues and a halfe for a degree of the greater circle. And yf by euery lyne you desire to know this computation of leagues, after. 16. leagues and two terces for a degree, or for more or lesse leagues or myles, multiply those such degrees by the number of the leagues or myles which enter into euery degree, & lykewise shall you number the minutes that are more then the degrees, by

One degree of variation of the pole.

Departyng from the Meridian lyne.

Degrees of the greater circle.

the


1 G L 17 1/2
1 G 1 M L 17 5/6
1 G 5 M L 19 ALMOST
1 G 12 M L 21 1/20
1 G 25 M L 24 3/4
1 G 48 M L 31 1/2
2 G 37 M L 45 11/12
2 G 89 3/4 M
G 5 M 2 L 88
G 2 M 25 L 42 1/4
M 12 L 13 1/2
M 25 H 7 1/4
M 40 L 11 21/3
G 1 L 17 1/2
G 1 M 30 L 26 1/4

the same number of the leagues that enter in euery degree, deuiding them by fyftie, and that that shall come of the diuision, you shall toyne with the multiplication of the degrees, and that shall amount thereof, shalbe the leagues, and partes of leagues, that you in those suche degrees.

The. xiii. Chapter, how to set or make a prycke in the Carde of Nauigation.

The Mariners call the pricking of a poynt in the Carde, to see and appoynt in it, in what poynt or part of the sea the shyp is in Nauigation. For the perfourmyng whereof, it shalbe requisite that the Pilot knowe from what degree, or how many degrees of the altitude of the pole he departed, & with what wynde he sayleth. And when he desyreth to knowe where he is, let hym know the altitude of the pole, by some of the aforesayd rules. And yf (takyng the altitude) he fynde hym selfe in the same degrees where he was when he departed, his Nauigation hath ben from the East to the West, and what he hath gone can not be knowen but by the iudgement of a wyse and expert man, according to the swyftnesse or goodnesse of his shyp, with consideration of the more or lesse tyme he hath had, as we haue sayde before in the syxth Chapter. But yf he fynde him selfe in more or lesse degrees, let hym take two payre of compasses, and put the foote of one, in the poynt or place where his shyp was when he departed, and the other in the line or wind by the which he sayleth, and likewise let him set the one poynt of the other compasse in the graduation of the Carde, in that number of degrees that he fyndeth the altitude of the Pole, and the other poynt of the same compasse in the next lyne of East & West: and so with both the compasses, one in the one hande, and the other in the other hand, let hym goe ioynyng them togather, takyng good heede, that the poynt of the compasse do not swarue from the wynd whereby he hath sayled, neyther the poynt of the other compasse from the lyne of East and West, where he set it.

To knowe in what part or poynt the shyp is.

The altitude of the pole.

To fynde the distaunce by the Carde.

And

And folowyng those two compasses by these two lynes, vntyll the poyntes of the two compasses ioyne (that is to vnderstande, the poynt that was set in the place from whence he departed, and the other that was set in the degrees that were founde) then where these two poyntes do ioyne, is the poynt where the shyppe is. But (as we haue sayd in the syxth Chapter) they muste haue great respect to the wyndes and seas, and other thynges whiche experience sheweth them, to knowe yf they haue gone directly by that lyne, or yf they haue fallen from it, and to what part: the whiche I remit to the iudgement of men of good experience. From thence forwarde, they shall returne to kepe the same accompt, as when they departed from the hauen, especially when they change their course.

Aduertisementes to the Pilotes.

The. xiiii. Chapter, of the makyng and vse of the Instrument generall, to knowe the houres and quantities of the day, and at what wynde the Sunne ryseth and falleth.

TAke a rounde plate with a ryng or a handle aboue, as in the Astrolabie, drawyng a lyne from the ring downwarde passyng through the center, and another lyne that may cut it in ryght angles through the center: And this last lyne shalbe called the Horizon. Then shall you geue a circle vpon the center, leauyng so much space betweene it and the edge of the plate, that therein may be wrytten the numbers of the degrees: then also make another circle somewhat more within, leauyng lykewyse a space where the graduations may be deuided. This done, deuide one of the highest quadrantes towarde the left hand into 90. partes, which shalbe called the degrees of latitude, begynnyng the numbers of them from the ryng, & endyng the same in the Horizon. Then make another rundell somewhat lesse then this, in such maner that the degrees & numbers of the greater, remayne vncouered.

And

And deuide this lesse, by two Diameters into foure equal parts. And at the one ende of the one Diameter, leaue a poynt cõmyng forth of the lesse rundel, cut directly with the same Diameter by the one part, and this shalbe called the Inder or shewer. In this rundel you shall make a circle halfe, a fynger lesse then the rundel. Then with a compasse take. 23. degrees and a halfe from the Diameter, whiche signifieth the Equinoctiall: and where as end the. 23. degrees and a halfe, for euery parte make a ryght lyne from one poynt to another, so that this be a lyne of 47. degrees, and as muche more at the other ende of the sayde Equinoctiall. Upon euery one of these ryght lynes, you shall make a halfe circle, and deuide euery of them into syxe equall partes, whiche may aunswere to syxe signes, and euery signe into three partes, which may aunsweare to the tenthes or tenth partes of degrees: and yf the instrument be great, you shal deuide euery signe into fiue or moe partes, so that you may make it perfect & precise. This doone, from the poyntes or pyckes of the one halfe circle, to the poyntes of the other, draw certaine lynes whiche shalbe equidistaunt to the Equinoctiall. In the endes of these lynes, betweene the lesse circle, and the edge of the rundel, drawe also certayne lynes, whiche may reache vnto the begynnynges and endes of the signes: and in the toppe of the endes, or ouer the endes of these lynes, make an Arke, so farre distaunt from the lesse circle, as is the thicknesse of the edge of a peece of foure ryals of plate: And in the space that is left, graduate the signes from tenne to tenne, or as the diuision shalbe. The space that remayneth from thence to the edge of the rundel, you shal deuide by the halfe, and in it shalbe made twelue spaces, where you shall set the signes with theyr names or caractes orderly, so that Aries be next vnto the Equinoctiall, then Taurus towarde the part of the Inder, then Gemini: and turnyng towarde the Equinoctial, Cancer, Leo, Virgo. Lykewyse on the other parte of the Equinoctiall, Libra, Scorpio, Sagittarius. And turnyng to the Equinoctiall, Capricornus, Aquarius, Pisces. And thus hauyng signed the Zodiacke, you shal also signe or marke the houres in maner as foloweth.

The placyng of the twelue signes in the instrument.

The Zodiacke.

Deuide the lesse circle of this rundel into foure equal partes, so that euery quarter may haue sixe partes. Reduce this diuision to the Diameter, puttyng the ruler vpon the poyntes, equally distant from the Horizon. And where it toucheth the Equinoctial, make pyckes or poyntes, so that the Equinoctial remaine deuided into twelue partes. Then vpon one of the Troppykes geue a circle, whiche may haue the same Tropike for his Diameter. Deuide this circle into .24. equal partes, & reduce these diuisiõs to the Tropike, as is done in the Equinoctial, & from one Tropike to another: then the Equinoctial and the Tropikes beyng thus deuided with these pyckes or poyntes, you shal passe with a payre of compasses by euery poynt equally ordered from the Horizon, to the one and the other part: and these shalbe called houres, wryting in the endes of them theyr numbers, beginning the one part in one, and ending it in twelue. On the other part, begin the one in thoppositte part, and ende in twelue. This done, these rundels shalbe brought to theyr perfection. Moreouer, you shal make a triangle, with a ryght angle, hauing two equal sides that may make the ryght angle. Euery of these sides must be as long as is the Semidiameter of the greatest rundel: also, vpon and about the ryght angle, you shal make a lytle circle, whiche shal haue the same angle for his center, & on the one side of this tryangle, set two raysed places, as in the Astrolabie: on the contrary side of these raysed places, must be a hole, so farre distaunt from the center or angle, as is the Semidiameter of the circle of the lesse rundel. In this hole you must put a cheeue, hangyng thereat a little wayght or plommet, onely sufficient to holde the cheeue straycht, so that it cause nothyng of the rundels to turne, or the instrument to decline. Furthermore, in a circle as bygge as the lesse of the lesse rundel, you shal deuide into .32. partes the eyght wyndes, and halfe wyndes, and quarters of wyndes. And being thus reduced to their Diameters (as is doone in the Equinoctial) you shal translate them in the sides of the triangle, in the which by the center of his litle circle, and by the center of the rundels, all the three peeces must be made fast with an axes or a nayle, so that they may be turned about close and very iuste. Then put a ryng in the handle of the instrument, wherby it may hang,

Diuision of the Equinoctial & Tropikes.

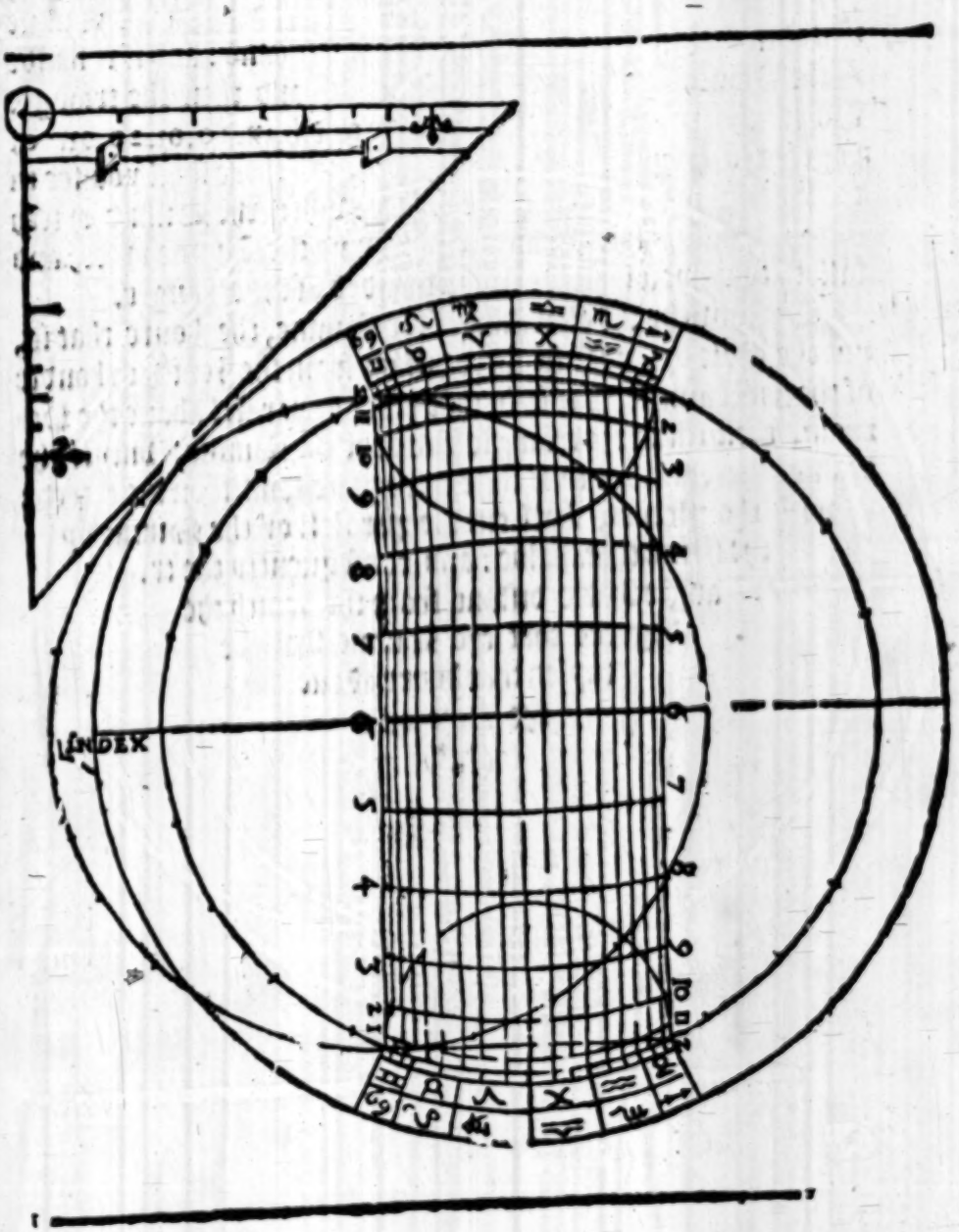
The houres with theyr numbers.

The triangle.

Diuision of the wyndes.

hang, as in the Astrolabie: and so shall the Instrument be fynished and brought to perfection.

This is the trace or draught of the Instrument.



To know at what houre the Sunne ryseth or falleth.

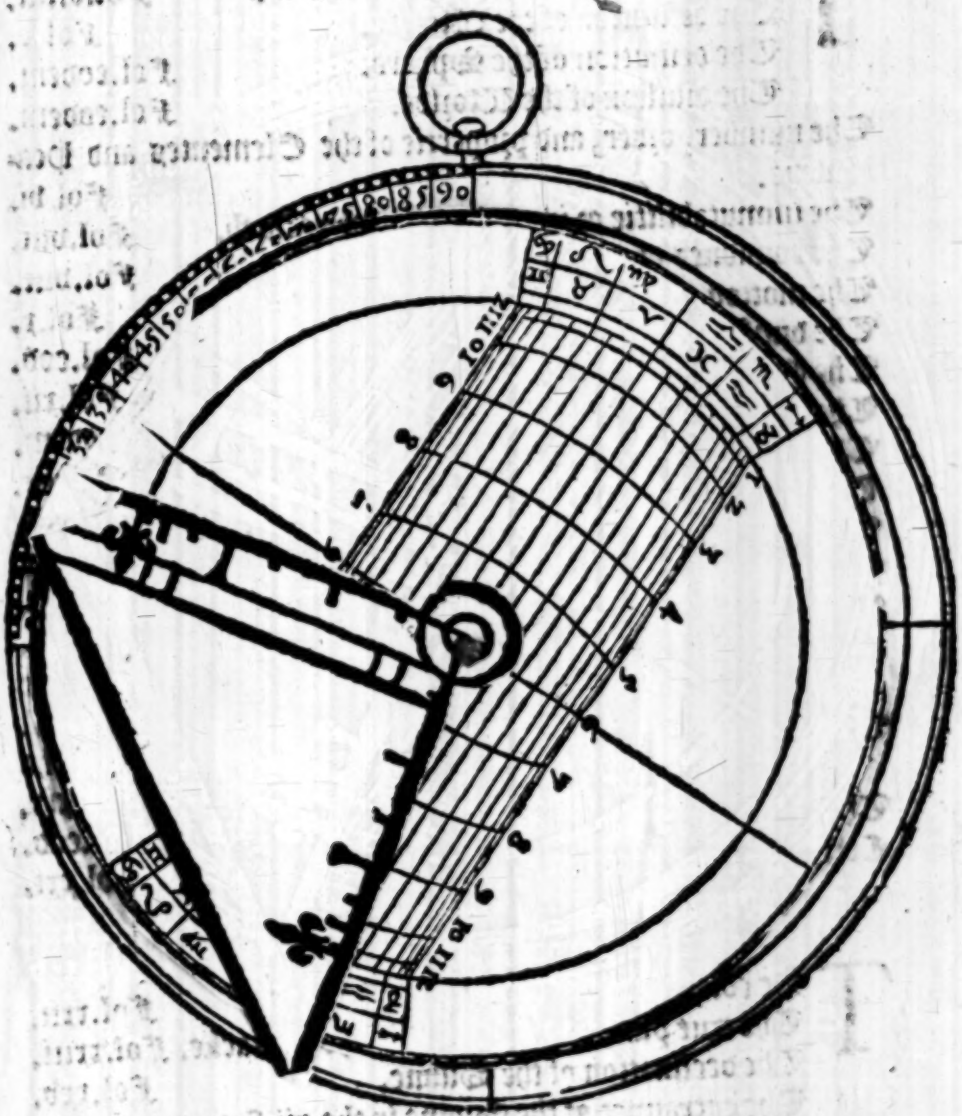
To know at what houre the Sunne ryseth and falleth (by the Instrument folowyng) you shall put the Pole of the lesse rundel (which is the index) to the left hand in the greatest rundell, in so many degrees aboue the Horizon, in how many degrees the Pole is rayſed in that lande or place. Then put the triangle, (which is the Horizon) in his place: that is to say, yf the Sunne shalbe in the North signes, put it to the left hand: and if it shalbe in the South signes, to the ryght hand, and then the triangle shal cut the paralel where the Sunne goeth, in. 10. or. 20. or. 30. degrees, or proportionally where it is, and there shall you see in the sydes of the Zodiacke, the houres when the Sunne ryseth and falleth. And lykewyse at what wynd the Sunne ryseth and falleth to vs, you shall see in the wyndes of the tryangle.

At what winde the Sunne ryseth or falleth.

To know by the eleuation of the Sunne, the houre that is, put the Pole or Index so farre distant from the Zenith or handle of the Instrument, as it is in that place or paralel aboue the Horizon, then turne the triangle towarde the Sunne, vntyll the beames thereof enter in at the rayſed plates, and then the threede with the plomet, shall cut the paralell of the Sunne by the houre that shalbe: and consequently the triangle shalbe distant from the Zenith the degrees that the Sunne shall be rayſed that houre aboue the Horizon.

(***)

This is the Demonstration.



FINIS.

Here beginneth the table of this Booke.

The contentes of the Chapters of the fyrſt part.

The generall deſtinction of Creatures. Folio.iiii.
The deſinition of the Woꝛlde. Fol.v.
The definition of the Sphere. Fol.eodem.
The diuiſion of the Woꝛlde. Fol.eodem.
The number, oꝛder, and pꝛopertie of the Elementes and Heauens. Fol.vi.
The immutabilitie oꝛ immobilitie of the Earth. Fol.viii.
The roundnes of the Earth and Water. Fol.viii.
The motion of the Heauens and Elementes. Fol.x.
The diuiſion of the Sphere into foꝛmall partes. Fol.eod.
The Equinoctiall circle. Fol.xii.
The Zodiacke. Fol.eodem.
The circle called Colurꝰ. Fol.xiii.
The Meridian circle. Fol.xiiii.
The Hoꝛizontall circle. Fol.eod.
The foure leſſe circles. Fol.xv.
The fyue Zones. Fol.xvi.
The Longitude and Latitude. And of the pꝛopoꝛtion which the leſſe circles haue to the great circle. Fol.xviii.
The circute oꝛ compaſſe of the earth & water, accoꝛdyng to the opinions of the auncient and later auethours. Fol.xix,
The.vii. Climates. Fol.eod.
Certayne pꝛinciples of this ſcience. Fol.xxi.

The Contentes of the ſeconde part.

The courſe of the Sunne in the Zodiacke. Fol.xxii.
The true place of the Sunne in the Zodiacke. Fol.xxiii.
The declination of the Sunne. Fol.xxv.
The entraunce of the Sunne in the.xii.ſignes, and of the Equinoctials and Solſtitials which deuide the foure tymes of the yeere. Fol.xxvii.
Of the Moone and her motions and pꝛoperties. Fol.xxix.
The coniunctions & oppoſitions of the Sun & Moone. Fol.xxx

The

The declaration and vse of an instrument, by the which is found the place and declination of the Sunne, with the dayes and place of the Moone. Fol.xxxi.
The Eclipses of the Moone and the Sunne. Fol.xxxiii.
Of tyme, and the definition thereof. Fol.xxxv.
Of the yeere, and the diuers beginnynges and reckonynges or computations had thereof in olde tyme. Fol.xxxvi.
Of the moneth, and of his differences. Fol.xxxvii.
Of the weeke. Fol.xxxix.
Of the day and nyght. Fol.xl.
Of houres. Fol.xl.
The making and vse of an vniuersal Dyal for the day. Fol.xli.
Of certaine perticuler Dials, Mural & Horizontal. Fol.xliii.
The composition and vse of an instrument for the houres of the nyght. Fol.xlv.
The time of the tydes, or ryslng & fallyng of the sea. Fol.xlviii.
Of certayne signes whiche prognosticate tempestes, or fayre weather. Fol.l.
Of the bright and shining exhalations that appeare in tempestes which the Mariners cal Santelmo or Corpus sancti Fol.li.

The Contentes of the thirde part.

The number, order, and names of the windes. Fol.liiii.
The composition of Cardes for the Sea. Fol.lvi.
The vertue and propertie of the Loue stone, called in Latin, Magnes, and in Spanysh, Piedrayman. Fol.lxii.
The making of the Mariners compasse for Nauigation. Fol.lxiii
The effect & propertie that the compasse hath to Northeastyng or Northwestyng, whereby is knowen the variation of the compasse. Fol.lxiiii.
The introduction & principles of the art of nauigatiō. Fol.lxvii
The making and vse of the Astrolabie, with the which the Mariners take the altitudes of the Sunne. Fol.lxviii.
The definition of the altitudes, and how the altitudes of the pole may wel be knowen by the Meridian altitude & declination of the Sunne. Fol.lxxi.

The

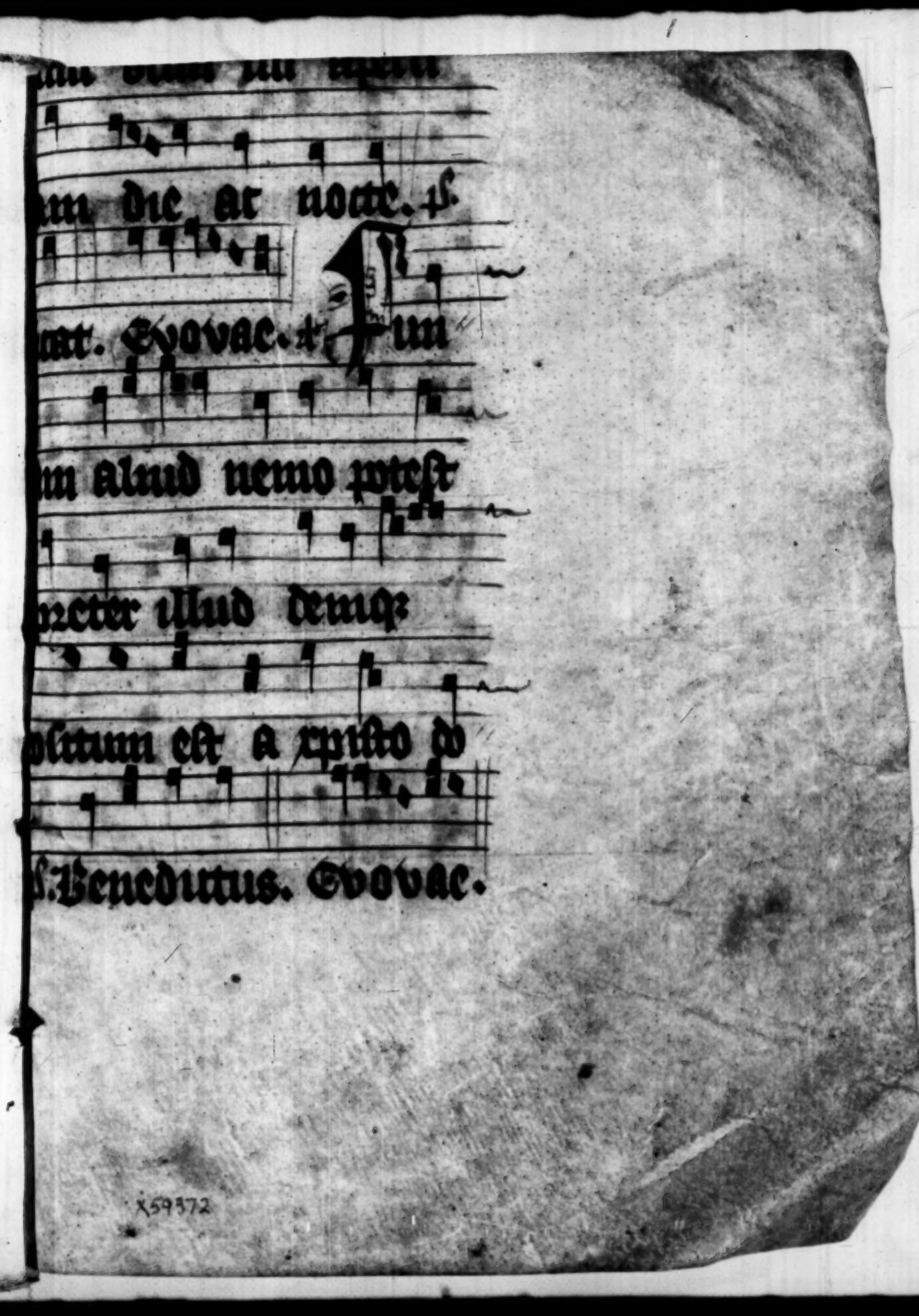
The makyng of the croſſe ſtaffe, wherewith the Mariners take the altitude of the North ſtarre. Fol. lxxii.
How the altitude of the Pole is knowen by the altitude of the North ſtarre. Fol. lxxiii.
The compoſition & vſe of an Inſtrument, by the which without obſeruyng the South Sunne or midday, is knowen the altitude of the Pole, and the houre that is. Fol. lxxv.
Of the leagues that are run for a degree, according vnto diuers courſes. Fol. lxxviii.
How to ſet or make a pricke in the carde of nauigation. Fol. lxxx
Of the makyng and vſe of an Inſtrument general, to know the houres and quantities of the day, and what winde the Sunne ryſeth and falleth. Fol. eod.

FINIS.

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1584.

CVM PRIVILEGIO.


m die ar nocte. ℣.
ant. Evovae. ℟ Tum
m aliud nemo potest
xcter illud demq:
olitum est a xpisto d
℣. Benedictus. Evovae.